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MEASURES TO STRENGTHEN INTERNATIONAL CO-OPERATION IN NUCLEAR, RADIATION AND WASTE SAFETY

NUCLEAR SAFETY REVIEW FOR THE YEAR 1997

1. The attached Nuclear Safety Review for the year 1997, which aims - like previous reviews[1] - to report on worldwide efforts to strengthen nuclear safety, is in four parts.

2. Part I describes those events in 1997 that have, or may have, some wider significance for nuclear safety worldwide. It includes developments such as new initiatives in international co-operation, events of safety significance and events that may be indicative of trends in safety.

3. Part II briefly describes some of the Agency's safety related activities during 1997. It covers legally binding international agreements, non-binding safety standards, and the application of safety standards. These issues are described in greater detail in document GC(42)/INF/5.

4. Part III is a summary prepared by the Secretariat of information provided by Member States on significant achievements, developments and issues related to nuclear, radiation and waste safety. For the information of the General Conference, the contributions from Member States (which have undergone minor editing) are reproduced in the Annex to the present document.

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[1] In the past, the Nuclear Safety Review has been issued as part of the IAEA Yearbook. This year, it is being issued as an information document for the General Conference. It should also be noted that the previous practice of using the year of issue in the title of the Nuclear Safety Review has caused some confusion. The title of this year's Nuclear Safety Review is intended to indicate clearly the year to which the Review refers.

For reasons of economy, this document has been printed in a limited number.
Delegates are kindly requested to bring their copies of documents to meetings.

5. Part IV presents a look ahead to some issues that are likely to be prominent in the coming year(s). These issues, however, are not discussed in detail, and the topics covered were selected by the Secretariat on the basis of trends observed in recent years and taking account of planned or expected future developments.

6. A draft version of the Nuclear Safety Review for the year 1997 was submitted to the Board of Governors for consideration at its March 1998 session. The present version has been prepared in the light of the discussion in the Board and information on significant achievements, developments and issues in nuclear, radiation and waste safety in 1997 provided by 27 Member States.

THE NUCLEAR SAFETY REVIEW FOR THE YEAR 1997

FOREWORD

The Nuclear Safety Review attempts to summarize the global nuclear safety scene during 1997. It starts with a discussion of significant events during the year. This is followed by a brief description of the principal IAEA activities that contributed to global nuclear safety. The third part of the Review highlights developments in Member States, as reported by the States themselves. The Review closes with a description of issues that are likely to be prominent in the coming year(s).

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PART I

SAFETY RELATED EVENTS AND ISSUES WORLDWIDE

This section aims to identify those events from which generally applicable lessons can be learned, those with potential long term consequences (whether good or bad) and those that could be indicative of developing trends (again, either good or bad) that might be of longer term importance. It is not intended to provide a comprehensive account of all events during the past year.

INTERNATIONAL CO-OPERATION

Intergovernmental Agreements

Legally binding agreements between States are increasingly important mechanisms for improving nuclear, radiation and waste safety worldwide. The number of bilateral and regional agreements continues to grow, and more and more States are becoming Parties to the international Conventions. There were three major events in this latter context during 1997:

- The Preparatory Meeting of the Convention on Nuclear Safety;
- The Diplomatic Conference to adopt the Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management; and
- The Diplomatic Conference to adopt a Protocol to Amend the Vienna Convention on Civil Liability for Nuclear Damage and the Convention on Supplementary Compensation for Nuclear Damage.

The Convention on Nuclear Safety entered into force on 24 October 1996. In accordance with the terms of the Convention, a Preparatory Meeting of the Contracting Parties was held from 21 to 25 April 1997 in Vienna and adopted rules of procedure, financial rules and guidelines for the preparation of national reports. Thirty-four States participated — 31 that were Contracting Parties, plus 3 who had deposited instruments of ratification less than 90 days before the Meeting — under the chairmanship of Mr. L. Högberg of Sweden. At the end of 1997, 42 States had agreed to be bound by the Convention. Twenty-six of the Contracting Parties have at least one operating power reactor (a “nuclear installation”, as defined in the Convention), but there remain five States that have such nuclear installations and are not yet Contracting Parties to the Convention.

The Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management was adopted by vote at the Diplomatic Conference, held in Vienna from 1 to 5 September 1997, and opened for signature on 29 September 1997, the first day of the 41st IAEA General Conference. The discussions at the Diplomatic Conference were dominated by the issue of transboundary movement of spent fuel and radioactive waste (see discussion in Parts II and IV), and some States continued to express reservations about spent fuel and radioactive waste being addressed together. Nevertheless the Joint Convention was adopted by an overwhelming majority, and by the end of 1997, 26 States had signed it (one State — Norway — deposited an instrument of ratification in January 1998). The Joint Convention, like the Convention on Nuclear Safety on which it was modelled, is an 'incentive convention', and is based on a similar system of national reports on safety activities being subjected to 'peer review' by the other Contracting Parties. The scope of the Joint Convention includes the management of spent fuel and radioactive waste (including discharges of liquid and gaseous radioactive materials into the environment) from civilian applications, with the exceptions of spent fuel held at reprocessing facilities and waste containing only naturally occurring radioactive materials. These excepted materials — along with material from defence or military applications — may be brought into the scope if a Contracting Party chooses to declare them as such.

In September 1997, governments took a significant step forward in improving the liability regime for nuclear damage. At a Diplomatic Conference at IAEA Headquarters in Vienna, 8–12 September 1997, delegates from over 80 States adopted a Protocol to Amend the 1963 Vienna Convention on Civil Liability for Nuclear Damage and also adopted a Convention on Supplementary Compensation for Nuclear Damage. The Protocol sets the possible limit of the operator's liability at not less than 300 million Special Drawing Rights; roughly equivalent to 400 million US dollars. The Protocol also contains, inter alia, an enhanced scope which covers costs of reinstatement of damaged environment and costs of preventive measures, extends the geographical scope of the Vienna Convention and extends the period during which claims may be made for loss of life and personal injury. The Convention on Supplementary Compensation provides for additional compensation through contributions by States on the basis of their installed nuclear capacity of civilian reactors and UN rate of assessment. States without nuclear reactors and which are at the minimum UN rate of assessment are not required to make contributions. The Convention is an instrument to which all States may adhere regardless of whether they are parties to any existing nuclear liability conventions or have nuclear installations on their territories. Both the Protocol and the Convention have a phasing-in mechanism which allows a State to join them, during an interim period, with a lower national compensation amount. They also provide, as an exception to the general rule, for jurisdiction of the courts of a coastal State over actions for nuclear damage arising during transport from incidents within its exclusive economic zone. Taken together, the two instruments should substantially enhance the global framework for compensation well beyond that foreseen by existing Conventions. The Protocol and Convention were opened for signature on 29 September 1997, at the 41st IAEA General Conference; by the end of 1997, each had been signed by nine States.

Co-operation between National Regulatory Bodies

The heads of the nuclear regulatory bodies in Canada, France, Germany, Japan, Spain, Sweden, the United Kingdom and the United States of America formed the International Nuclear Regulators' Association (INRA). The inaugural meeting of the Association in May 1997 appointed Ms. S.A. Jackson of the US Nuclear Regulatory Commission as Chairman for two years. These first two years are envisaged as a 'trial period', during which membership will be limited to representatives of the eight States listed above; the question of whether, and if so how, to extend the membership will be addressed after this period of consolidation. The Association aims, inter alia, to provide the regulators with a forum for discussing policy issues of common interest, to identify emerging regulatory challenges and to enhance the stature of nuclear regulators and their work worldwide. Specific issues to be addressed include the regulatory implications of the restructuring of electricity industries and assistance to the regulatory bodies of central and eastern Europe.

The organizations responsible for nuclear safety and radiation protection in Argentina, Brazil, Cuba, Mexico and Spain have established a Forum of Ibero-American Regulatory Bodies for the exchange of technical, legal and organizational information of mutual interest. The initiative will include initially those countries which have nuclear power plants in construction or in operation. The activities of the Forum should be complementary to the existing international programmes of nuclear safety and radiation protection, such as those of the IAEA, and will promote the exchange of experience among countries with close cultural and social relations. The first annual meeting of the Forum took place in Mexico in July 1997.

The creation of the INRA and the Ibero-American Forum follows a pattern established by the formation of regulators' organizations based on reactor type and/or regional considerations, with the aim of improving safety by exchanging regulatory information and experience. For example:

- The Co-operation Forum for WWER Regulators was formed in 1993 to encourage the sharing of information and pooling of experience between regulators from the States operating WWER reactors: Armenia, Bulgaria, the Czech Republic, Finland, Hungary, the Russian Federation, Slovakia and Ukraine (with Germany, USA, IAEA and the Nuclear Energy Agency of the Organisation for Economic Co-operation and Development — OECD/NEA — as observers). The fifth annual meeting of the Forum was held in Helsinki in August 1997, and included progress reports from the participants, reports from working groups on in-service inspection, radiation embrittlement and licensing of dry spent fuel storage facilities, and detailed discussion on the problems and operating experience with WWER-1000 plants.
- A similar group comprising senior regulators from countries with CANDU reactors — Argentina, Canada, China, India, Republic of Korea, Pakistan and Romania — held its third annual meeting in October 1997 (with support from the IAEA), and discussed issues such as the events at Ontario Hydro (see below), plant safety

indicators, generic safety issues, backfitting experience and national reports for the Nuclear Safety Convention.

- The IAEA has since 1989 organized peer discussions on regulatory practices, aimed at promoting information exchange and identifying and disseminating commonly accepted good practices. These discussions take the form of a series of meetings between regulators discussing a specific issue chosen by the Agency's Advisory Commission on Safety Standards. The subject for the discussions in the 1996–1997 session — in which regulators from 22 Member States participated — was "Approaches Relating to the Decommissioning of Nuclear Facilities", and a report describing the conclusions will be published in the near future. The first meeting of the 1997–1998 series on "Regulation of the Life Cycle Management of Nuclear Installations" was held in September 1997.

On 30 October 1997, officials from eight Asian countries on the Pacific, as well as from Australia, met in Seoul, Republic of Korea, for the second annual conference on nuclear safety in Asia. Observers from ten other countries, and from the IAEA and OECD/NEA also attended. Participants agreed on the need to take concrete measures to further improve nuclear safety in the region. They exchanged views on safety related issues and made suggestions to develop concrete measures for co-operation.

Activities of International Organizations

Some of the safety related activities of the IAEA are described in more detail in Section II. Other international organizations active in nuclear safety related areas include the World Association of Nuclear Operators (WANO) and the Nuclear Energy Agency of the OECD (OECD/NEA).

WANO's mission is to maximize the safety and reliability of the operation of nuclear power plants by exchanging information and encouraging communication, comparison, and emulation amongst its members. All organizations operating commercial nuclear power plants are members of WANO. In 1997 WANO conducted peer reviews at 24 of its members' nuclear power plants, and there are 24 peer reviews scheduled for 1998. Although WANO peer reviews and IAEA OSART missions are each unique and separate, they are complementary in that each strives to enhance nuclear plant safety and reliability. Scheduling of these visits is co-ordinated between the two organizations. WANO has also established a new Technical Support and Exchange Programme to provide response to specific requests for assistance from its members. Twenty-two technical support missions were conducted in 1997 as part of the development of this programme. Other ongoing WANO programmes — operating experience, good practices, performance indicators, workshops and exchange visits between plants — contribute to the safe and reliable operation of WANO members' nuclear power plants and continue to develop and expand with increasing member participation and use.

The OECD/NEA has programmes of work in nuclear safety and regulation, radiation protection and radioactive waste management. Some of their work is mentioned elsewhere in the Review, but other areas of current interest include:

- The preparation of reports describing the 'state of the art' in OECD States (and sometimes non-OECD States) on a range of safety related issues;
- The Information System on Occupational Exposure (ISOE) aims to provide its participants (regulatory authorities and utilities) with an information and data exchange on occupational exposure in nuclear power plants and methods to improve the protection of workers. The ISOE is now co-sponsored by the IAEA, allowing non-OECD States to participate;
- The second part of International Emergency Exercise programme INEX 2 was held at Loviisa, Finland, in April 1997, and included participants from 28 countries and 5 international organizations (including the IAEA). Two further regional exercises scheduled for 1998 — in Canada and Hungary — will complete the INEX 2 programme.

REACTOR FACILITIES

A number of events in 1997 highlighted the need for continuous efforts to maintain and improve nuclear safety, even in long established nuclear programmes such as those of western Europe and North America. The three examples described below — from Canada, USA and Sweden — suggest that successful nuclear programmes can experience a gradual deterioration in safety performance. This issue is discussed further in Part IV.

In August 1997, Ontario Hydro — Canada's main nuclear power plant operator — announced a major plan of action for its production facilities, including the closure for an indefinite period of 7 reactors at the Bruce A and Pickering A nuclear power plants and major improvements in the management of operation and maintenance at the 12 reactors at Bruce B, Pickering B and Darlington stations. This followed the report of a team of experts from Canada and the USA, commissioned by Ontario Hydro's management to provide an independent assessment of their nuclear operations. The team concluded that the overall standard of safety at the operating stations was "minimally acceptable"; i.e. their operation met defined regulations and accepted standards of nuclear safety, but fell substantially below industry standards of good practice. Many specific and detailed criticisms of Ontario Hydro's operations, particularly in areas of management, were made in the report. A general overall conclusion was that the company had failed to adapt sufficiently well to the different needs of day-to-day safety in the operational phase — particularly the increased importance of safety management concepts such as safety culture and self assessment — as compared to the design and construction phase. The independent review confirmed the position that the Canadian regulator had expressed over a number of years, namely that safety performance was deteriorating and that corrective action was necessary if unrestricted operation was to be permitted.

In June 1996, the Millstone nuclear power plant in Waterford, Connecticut, USA, was designated a Category 3 facility by the Nuclear Regulatory Commission (NRC), meaning that it could not be restarted until the licensee, the Northeast Utilities Service Company (NU), demonstrates that adequate programmes have been established and implemented to ensure substantial improvements in safety. This followed several years in which there was a high volume of employee concerns and allegations about safety at the three Millstone units, and about management attitudes towards staff raising such concerns. An independent review group established by the NRC reported in September 1996 its view that the problems were primarily attributable to "top management failure to provide the dynamic and visible leadership needed to bring about required, basic attitude changes", and noted that the problems identified in their review had all been identified to NU management previously. Following the regular reviews of their 'watch list' in January and June 1997, the NRC determined that Millstone should continue to be designated a Category 3 facility. As of the end of 1997 the station remains shut down.

In August 1997, it was discovered that operators at the Ringhals-2 nuclear power plant in Sweden had preheated the reactor — a preliminary to powering up after a maintenance outage — without realizing that the emergency core cooling system was not in a poised state. Before an internal investigation was completed, a similar incident occurred at Ringhals-3 in September. A further incident in which control room staff failed to notice that a safety system valve was not correctly set was detected in October at Oskarshamn-1; the operators immediately took the plant off-line. The nuclear safety authority SKI responded by requiring plant managers from all nuclear power plants to submit by the end of 1997 detailed plans for guarding against such incidents.

The previous Nuclear Safety Review reported on concerns about the 6.5 MW(th) heavy water research reactor at the Institute of Nuclear Sciences at Vinča, near Belgrade. In 1995, concern about the condition of the spent fuel storage pool — which contains about 7500 spent fuel slugs in aluminium drums and stainless steel fuel channel holders — prompted the Institute to request assistance from the IAEA. Missions to Vinča, in November 1995 and October 1996, assessed the situation and identified the remedial actions needed. The most acute problem was considered to be the possible overpressure in the aluminium drums. A third mission — supported, like the previous missions, by a contribution from the Italian Government — visited Vinča in February 1997, and assisted in producing a detailed work plan for the necessary remedial actions. The first stage of this plan, removing the sludge and cleaning the pool, was started by local staff, and a contract has been signed with a Russian company for the task of venting the drums. The project is being financed by the Yugoslav Government and, as requested by the reactor management and the Government, the Agency will continue to provide expertise and advice as necessary.

Responding to concerns about the stability of the 'sarcophagus' containing the remains of Chernobyl Unit 4, a phased approach to address the safety issues was proposed by groups of international experts. The concept was developed into a Shelter Implementation Plan (SIP) in the Spring of 1997, including in the first phase measures to stabilize the present sarcophagus conditions. It is expected that the SIP will take eight or nine years to complete, at a cost of approximately $750 million. A Pledging Conference took place in November 1997 at the UN Headquarters in New York, for prospective donors to subscribe funds in addition to the original $300 million pledged by the 'Group of Seven' (G-7) countries during their Denver Summit of June 1997. The European Bank for Reconstruction and Development (EBRD) was invited by the G-7 to establish and administer the Chernobyl Shelter fund. The Board of the EBRD approved the participation of the Bank in September 1997 and the Rules of the Fund in November 1997.

SAFE MANAGEMENT OF RADIOACTIVE WASTE

In October 1997, the US Environmental Protection Agency (EPA) announced its proposed decision that the Department of Energy's (DOE) Waste Isolation Pilot Plant (WIPP) will meet the necessary protection standards for disposal of long lived transuranic radioactive waste from defence activities. This proposed decision is based on the DOE's formal application made in May 1997; a final decision — which will follow a round of public consultation — is required within one year of receipt of the application, i.e. by May 1998. The DOE's application had been considered in the light of a review by the US National Academy of Sciences of the standards being applied, and a review of the DOE's assessment by an International Review Group organized by the OECD/NEA and IAEA.

Also in the USA, the Nuclear Regulatory Commission (NRC) published its Final Rule on radiological criteria for termination of nuclear facility licences after decommissioning. The rule allows sites to be released for unrestricted use if the doses from residual radioactive material are below 25 mrem (0.25 mSv) per year and as low as reasonably achievable. If institutional controls are needed to keep the doses below 25 mrem/y, then the site may be released for restricted use (which excludes, inter alia, use for housing), subject to certain administrative requirements designed to demonstrate the reliability of the controls and assurance that failure of the institutional controls would not lead to doses in excess of 100 mrem (1 mSv) per year. The choice of the 25 mrem/y criterion, and the NRC's decision not to include a separate criterion specific to doses from groundwater, were the source of disagreement between NRC and EPA. As the need grows to decommission old facilities, several other States are considering criteria to be applied for licence termination, and the developments in the USA will be watched with interest.

Considerable controversy surrounded proposals by the Taiwan Power Company of Taiwan, China to export low level radioactive waste to the Democratic People's Republic of Korea (DPRK). A resolution by the National Assembly of the Republic of Korea (reproduced in the Attachment to INFCIRC/534) strongly urged that the proposals be revoked, noting international practice that radioactive wastes should be disposed of in the country in which they were generated and recalling the Lomé Convention, which prohibits the direct or indirect export of radioactive waste from Member States of the European Union to the contracting States in Africa, the Caribbean and the Pacific (the ACP States). As of the end of 1997, no waste had been transferred to the DPRK.

Transports of radioactive waste were also very much in the news in 1997; these are addressed below in the section on transport of radioactive materials.

MEDICAL USES OF RADIATION SOURCES

As reported in the previous Nuclear Safety Review, it emerged in September 1996 that 115 radiotherapy patients at a hospital in San José, Costa Rica had received higher than intended doses from an incorrectly calibrated cobalt-60 source. Assistance was requested under the terms of the Convention on Assistance in the Case of a Nuclear Accident or Radiological Emergency. At the request of the Costa Rican Government, an international team of experts assembled by the IAEA visited San José in July 1997. In collaboration with local professionals, they evaluated the causes and effects of the accident, provided advice on follow-up actions and made recommendations on improving safety in radiotherapy (a new report on this issue is being prepared by the IAEA). The team estimated that the calibration error had resulted in the actual doses delivered being 50–60% higher than intended; they concluded that this overexposure had been the direct cause of the deaths of 3 patients, and a contributory factor in the deaths of a further 5 (in total, 42 of the patients had died by the time of the team's visit). In addition, 20 of the patients who were still alive had suffered major adverse health effects. The cause of the overexposure was determined to have been an arithmetical error, and inadequate quality assurance made it possible for this error to become an accident.

The first global requirements for the radiation protection of patients were established in the International Basic Safety Standards for Protection against Ionizing Radiation and for the Safety of Radiation Sources in 1996. In June 1997, the Council of the European Union adopted the "Council Directive on Health Protection of Individuals against the Dangers of Ionising Radiation in relation to Medical Exposures" (97/43/EURATOM). This is intended to clarify and extend the scope of the previous Directive on the subject, issued in 1984, and is mandatory in the Member States of the European Union. The new Directive highlights some particular situations, such as exposure of children, pregnant women and nursing mothers, use of radiation in health screening programmes, high dose procedures and potential exposures, and also gives greater attention to training. The Directive requires justification and optimization arguments to be applied at two levels — generically, for a particular type of procedure, and individually, in the context of a particular patient undergoing a particular procedure. It also places the justification requirement on both the person prescribing the procedure involving radiation and the person delivering the exposure. In its explicit requirement to consider alternative diagnosis or treatment methods in every case, the new Directive goes beyond the requirements for the justification of practices involving radiation in the 1996 Euratom Basic Safety Standards Directive. In addition to the justification principle, the Directive also stresses the value of optimization as a very important tool for radiation protection purposes. It introduces concepts such as quality assurance and diagnostic reference levels, and requires special attention to the exposure of volunteers and persons helping a patient.

EVENTS AT OTHER FACILITIES

On 11 March 1997, a fire broke out in a bituminization demonstration facility at the Tokai reprocessing plant in Japan, operated by the Power Reactor and Nuclear Fuel Development Corporation (PNC). A sprinkler system was activated, and the incident seemed to be over, but ten hours later an explosion or explosions occurred. Thirty-seven workers received small doses, mainly from inhaled radioactive material, and there was a small release of radioactivity (within the authorized limits for normal operation) from the site. The direct cause of the fire was found to have been a chemical reaction in a drum containing bitumen and low level radioactive waste; the reason for the subsequent explosion was apparently that the time for which the water sprinkler operated was insufficient to extinguish the fire completely, and there was no proper verification that the fire was out.

On 17 June 1997, a worker at the All-Russian Research Institute of Experimental Physics in Arzamas-16 (Sarov), Russian Federation was exposed to a sudden abnormally high neutron flux from a critical assembly on which he was working. The whole body dose was estimated, from a dosimeter on his chest, to have been 45–50 Gy (predominantly neutron dose), and doses to the worker's hands were estimated to have been 350–450 Gy. He suffered widespread edema, and died 64 hours after the exposure from multiple organ failure. Investigations into the accident suggested that the direct causes were procedural and calculation errors by the worker himself, and that the work was being carried out alone, in contravention of safety regulations. Assistance was requested by the Russian Federation under the Convention on Assistance in the Case of a Nuclear Accident or Radiological Emergency; the requested medical materials were urgently obtained by the Agency, and promptly delivered to Moscow (where the victim was being treated), but arrived on the day on which he died.

In June 1997, an explosion and fire occurred at a gas extraction well in Bangladesh, operated by a petroleum company, at which neutron and gamma radiation sources were being used. On 26 June, the IAEA received a request from the Bangladesh Atomic Energy Commission (BAEC) for assistance under the Convention on Assistance in the Event of a Nuclear Accident or Radiological Emergency, reporting that a number of the sources had not been accounted for. The Agency was, however, informed that the site was inaccessible as a result of the fire and risk of further explosions. An Agency mission to investigate the situation was eventually approved and went ahead in October. On the day of arrival, the mission team was informed that the sources had been located a few days earlier by petroleum company workers. The mission team then worked with representatives of BAEC and the petroleum company to check the sources, which were still in their containment. No residual contamination was detected and the sources were removed to safe storage.

On 9 October 1997, the Georgian Ministry of Health reported that nine servicemen of the Lilo Centre Detachment of Frontier Troops had developed radiation induced skin injuries, and requested assistance from the IAEA. The injuries were reported to have been caused by exposure to caesium-137 sources found on the military base where the men had been stationed, having apparently been left there by the Soviet Army. An Agency mission was sent immediately to the base, and found that the caesium and radium-226 sources were securely stored with adequate physical protection. The mission team also confirmed that dose rates at the site were at background levels, and detected no surface contamination. Medical treatment was provided under existing agreements between the World Health Organization (WHO) and the Agency; the injured servicemen were taken to either France or Germany for treatment. Under a rapidly introduced and implemented Technical Co-operation project, monitoring equipment and training is being provided to Georgia. A follow-up IAEA mission in December established that there are three other military sites near Tbilisi with radioactive sources and surface contamination. Georgian authorities reported that they are monitoring more than 300 other places for radioactive sources or surface contamination.

In July 1996, a worker at the Gilan Combined Cycle Power Plant in Iran found a lost industrial radiography source and, not knowing what it was, put it in his shirt pocket. When he became aware that the object could be harmful, he discarded it, but not before he had received a large radiation dose to his chest. This ultimately caused extensive injuries to the skin and underlying tissues. He was treated at the Curie Institute in Paris, where he received skin transplants. Although he has permanent scarring of the skin and some restriction of movement, he is otherwise now in good health. In collaboration with Iranian specialists, the Agency is preparing a report of the accident in order to disseminate the lessons learned from it.

TRANSPORT OF RADIOACTIVE MATERIAL

Transports of radioactive materials generated a great deal of publicity during 1997 as pressure groups intensified their efforts to stop such shipments. In Germany, protesters attempted to block a number of rail transports of spent fuel and radioactive waste, with some such demonstrations ending in violence. There were also increased diplomatic concerns expressed in relation to sea transports of vitrified high level waste between Europe and Japan by States en route, although the shipments were carried out in accordance with international regulations and agreements, notably the IAEA's Regulations for the Safe Transport of Radioactive Material and the International Maritime Organization's (IMO) Code for the Safe Carriage of Irradiated Nuclear Fuel, Plutonium and High-Level Radioactive Wastes in Flasks on Board Ships. Concerns which had been expressed by some Member States to the IMO — particularly with reference to the prior notification of States on the route of shipments — were echoed in other forums. Both the Diplomatic Conference on the Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management and the IAEA General Conference adopted resolutions on the issue of transboundary movement of radioactive materials, and the Governments of Argentina, Brazil, Chile and Uruguay issued a Joint Declaration on the Transport of Radioactive Waste (see Part IV).

PART II

AGENCY ACTIVITIES IN NUCLEAR, RADIATION AND WASTE SAFETY

In previous years, the Nuclear Safety Review has referred to a global nuclear safety culture comprising three key elements:

- Legally binding international agreements;
- Non-binding safety standards; and
- The application of safety standards.

As noted in Part I, legally binding international Conventions play an increasingly important role in improving nuclear, radiation and waste safety. The Agency assists this process by providing a range of functions, including acting as secretariat to meetings of Contracting Parties, and maintaining records of national points of contact. The Director General of the IAEA acts as depositary for the Conventions. Further information on the Conventions can be found in Annex A of General Conference document GC(42)/INF/5, or on the Agency's WorldAtom web site at www.iaea.org/worldatom/glance/legal/.

The development of international consensus standards and guidance on nuclear, radiation and waste safety are high priorities for the Agency. The process for the preparation and review of safety standards involves, in addition to the Agency's internal review and approval procedures, five advisory bodies made up of senior regulators nominated by Member States: four Advisory Committees concentrating on the specific areas of nuclear safety, radiation safety, radioactive waste safety and transport safety, and an Advisory Commission on Safety Standards addressing more general safety issues and overseeing the work of the Advisory Committees. The advisory bodies approve plans for the development of new or revised safety standards, review draft versions of documents (Member States also have an opportunity to comment directly on proposed standards) and eventually approve them. Over 60 safety related documents — some new, some being revised — are currently at various stages of the preparation and review process. A status report on the Agency's safety standards is given in Annex B of General Conference document GC(42)/INF/5.

The International Nuclear Safety Advisory Group (INSAG) — an independent advisory group to the Director General of the IAEA — is currently working on four main reports: a 'high level document' (as yet untitled) addressing the fundamental objectives and principles of nuclear, radiation and waste safety, an updated version of an earlier report (INSAG-3) on basic safety principles for nuclear power plants, and new reports on the safe management of ageing of nuclear power plants and on safety management.

THE APPLICATION OF SAFETY STANDARDS

The IAEA has an extensive ongoing programme of work to provide for the application of safety standards. This includes:

- Providing direct safety related assistance to Member States, through the Agency's regular budget, Technical Co-operation programmes and special extrabudgetary programmes;
- Fostering the international exchange of safety related information;
- Promoting education and training;
- Providing a wide range of safety related services, including radiological assesments, to Member States on request;
- Co-ordinating safety related research and development projects.

Safety Related Assistance

The Agency provides assistance in nuclear, radiation and waste safety to Member States through its regular budget, the Technical Co-operation programme and extrabudgetary programmes. Assistance on specific matters at the request of Member States has been provided by the Agency for many years, including assistance in the case of accidents (see the examples in Part I) and assistance related to the Agency's nuclear safety services to Member States (see below). Over the past few years, this 'assistance on request' has been supplemented by the development of more systematic programmes to improve basic safety infrastructure. Some examples are described below.

Radiation and Waste Safety Infrastructure

The Technical Co-operation Model Project on "Upgrading Radiation and Waste Safety Infrastructure" was initiated in 1994, and had progressed by 1997 to include 52 Member States (see Table I). The Model Project has been based on a systematic approach of assessing each State's existing safety infrastructure, comparing it to a reference model of an acceptable level of infrastructure — based on the requirements of the International Basic Safety Standards for Protection against Ionizing Radiation and for the Safety of Radiation Sources — and thus deriving an action plan of necessary improvements, and then implementing the action plan. The majority of these Country Safety Action Plans were completed by early 1997, and implementation is under way. Some results have already been achieved, notably in the control of radiation sources; by the end of 1998, over 80% of the participating countries should have approved (or be in the process of approving) legislation and regulations and established systems of notification, licensing and control of sources in accordance with the Basic Safety Standards, and over 70% should have a national inventory of sources. It is expected that all but a very small number of participating States will achieve a reasonable system of control for radiation sources.

TABLE I Member States participating in the Model Project
"Upgrading Radiation and Waste Safety Infrastructure"

Africa	West Asia/East Asia	Latin America	Europe
Cameroon	Bangladesh	Bolivia	Albania
Côte d'Ivoire	Jordan	Costa Rica	Armenia
Democratic Republic of the Congo	Kazakhstan	Dominican Republic	Belarus
Ethiopia	Lebanon	El Salvador	Bosnia and Herzegovina
Gabon	Mongolia	Guatemala	Cyprus
Ghana	Myanmar	Haiti	Estonia
Madagascar	Qatar	Jamaica	Georgia
Mali	Saudi Arabia	Nicaragua	Latvia
Mauritius	Sri Lanka	Panama	Lithuania
Namibia	Syrian Arab Republic	Paraguay	Republic of Moldova
Niger	United Arab Emirates		The former Yugoslav Republic of Macedonia
Nigeria	Uzbekistan		
Senegal	Viet Nam		
Sierra Leone	Yemen		
Sudan			
Uganda			
Zimbabwe			

Nuclear Safety Infrastructure

A new programme on nuclear installation safety — the "Integrated Strategy for Assisting Member States in Establishing/Strengthening their Nuclear Safety Infrastructure" — was proposed in 1996, and implementation was begun during 1997. This will be available only to those States receiving Agency assistance which have research reactors or nuclear power plants, and the number of States involved is therefore likely to be smaller. The key element of the strategy is that country nuclear safety profiles describing each State's existing safety infrastructure will be compared with a reference situation based on international safety standards — in this case the IAEA's Nuclear Safety Standards (NUSS) documents — to identify systematically where the Agency's assistance could most effectively be applied. During 1997 a set of questionnaires, based on the safety requirements in the five NUSS Codes, was developed for use in this comparison process. These questionnaires will be sent, together with draft narratives of the country nuclear safety profiles, to the Member States concerned early in 1998, allowing work on preparing country nuclear safety action plans to begin later in 1998.

Extrabudgetary Programmes

In 1990 the Agency started an extrabudgetary programme (EBP) on the Safety of WWER and RBMK nuclear power plants to enhance nuclear safety assistance to the countries of eastern Europe and the former Soviet Union. This has been supplemented in recent years by Technical Co-operation projects. The Member States supporting the EBP have requested that it be completed by 1998, with subsequent assistance being provided from the Agency's regular budget. As a result, the work in 1997 was increasingly focused on those areas considered to have the highest priority for the time remaining in the programme, namely the generic safety issues and the safety issues affecting the older reactors — 'small series' WWER-1000 plants and RBMKs of the first and second generation. Work is also under way to ensure that tasks which will not be completed in 1998 are transferred to regular budget projects of the Agency, including those of the Technical Co-operation programme, or to national, bilateral or other international programmes.

Discussions were also under way in 1997 on the establishment of an extrabudgetary programme on nuclear safety for the countries of south-east Asia, the Pacific and the Far East. The objective of the programme is to strengthen nuclear safety in the countries of the region, and in particular to enhance the capabilities of national regulatory authorities and technical support organizations. A 'kickoff' meeting in October was attended by 21 representatives of 13 Member States, and agreed on action plans for the programme. The programme will involve two phases, and will follow the pattern specified in the Agency's Integrated Strategy for Assisting Member States in Establishing and Strengthening their Nuclear Safety Infrastructure (see above). Phase 1 (1997–1998) will include national and regional training, and the development of country profiles and national action plans; these actions plans will then be implemented in Phase 2 (1999–2000). The Japanese Government has committed funds to finance implementation of the 1998 programme, and other States have indicated their willingness to provide financial contributions and cost free experts, and to host training activities. A notable and novel feature of this programme is that, unlike the programme in eastern Europe aimed at improving safety in a long established industry, it would in a number of cases be providing assistance to States as they consider developing nuclear power programmes.

Information Exchange

The Agency fosters the international exchange of safety related information by producing a wide range of publications aimed at different audiences, by organizing meetings, conferences and workshops and, increasingly, through electronic information systems. Full lists of safety related publications issued, and events organized by the Agency in 1997 are given in the Annual Report.

A number of Agency-sponsored meetings and conferences warrant special mention. The International Conference on Low Doses of Ionizing Radiation: Biological Effects and Regulatory Control — held in Seville, Spain in November — attracted over 500 participants from 65 countries and 5 international organizations. Other international conferences and symposia organized by the Agency included an International Conference on Physical Protection of Nuclear Materials: Experience in Regulation, Implementation and Operations (10–14 November) and a Symposium on Upgrading the Fire Safety of Operating Nuclear Power Plants (17-21 November), both held in Vienna. The Agency also supported an International Conference on The Radiological Accident in Goiânia — Ten Years Later, organized by the Brazilian Nuclear Energy Commission and held in Goiânia in October.

The Agency is increasingly using electronic means of disseminating information. In 1997 the International Basic Safety Standards for Protection against Ionizing Radiation and for the Safety of Radiation Sources (Safety Series No. 115) were issued on diskette as a Windows-based PC application. The program gives users access to the complete text of the Standards, enhanced with menu, search, index and cross-referencing functions. Two major new areas were added to the IAEA's Worldatom web site in 1997, providing information on the Agency's work in nuclear safety (http://www.iaea.or.at/ns/nusafe/) and radiation and waste safety (http://www.iaea.or.at/ns/rasanet/).

The Incident Reporting System (IRS), operated jointly by the IAEA and the NEA/OECD, provides a valuable tool in the exchange of information on safety significant events, their causes and lessons learned. Participants at the annual meeting of IRS co-ordinators in May 1997 noted that about one-third of the events being reported were recurrent events, and that this suggested that feedback of operational safety experience was not as effective as might be hoped. They therefore proposed that more attention be given to monitoring how, and to what extent, lessons learned are being acted upon. Analysis of events in the IRS is also used to identify subjects for topical studies; three such reports were issued in 1997, on human factors analysis, foreign material intrusion, and corrosion, erosion and sedimentation.

The Incident Reporting System for Research Reactors (IRSRR) was launched in mid-1997, and all Member States operating research reactors were invited to participate. The IRSRR is similar in character to, and compatible with, the existing IRS for nuclear power plants. It is expected that the database established by the IRSRR will prove to be a valuable service to the research reactor community worldwide. By the end of 1997, 13 Member States had notified the Agency of their participation in the IRSRR: Argentina, Austria, Brazil, Canada, Chile, Egypt, Finland, France, Hungary, Pakistan, Slovenia, Tunisia and Turkey.

Education and Training

Education and training are essential elements in the safe use of radiation, radioactive materials and nuclear technology. Pursuant to General Conference resolution GC(XXXV)/RES/552, the Agency supports, through its Technical Co-operation programme, regional and interregional educational courses covering a broad range of nuclear, radiation and waste safety issues, and specialized training courses and workshops on more specific subjects. A full list of Agency-sponsored regional and interregional courses can be found in the Annual

Report. In addition, the Agency also arranges local Training Courses and Workshops on specific subjects as part of its assistance and services to Member States.

Six interregional courses were held in 1997, on safe transport (held in the USA), emergency preparedness (USA), operational nuclear safety (USA), prevention and management of accidents in nuclear power plants (USA/Canada), management of reactor ageing (Canada/USA) and safety assessment for near surface repositories (Spain). The Post-Graduate Regional Training Course in Radiation Protection and Nuclear Safety (in Spanish), held in Buenos Aires, Argentina, from April to November 1997 was the 20th such course. Regional Basic Professional Training Courses in Radiation Protection were held in the Syrian Arab Republic — the first time that such a course has been held in Arabic — and in Germany (in English). A number of Regional Seminars were held on a range of basic safety infrastructure issues in connection with the Model Project on "Upgrading Radiation and Waste Safety Infrastructure" (see above), and a number of Regional Training Courses and Workshops on regulatory, inspection and licensing issues were held as part of the European Regional Project "Nuclear Safety Regulatory and Legislative Infrastructure".

Review and Assessment Services

Safety Services for Nuclear Installations

The Agency has for many years offered a range of services related to the safety of nuclear installations, provided on request to Member States; a comprehensive list of the missions and seminars carried out in 1997 is given in the IAEA's Annual Report, and some examples are described below. In addition to the development of the Integrated Strategy on nuclear safety infrastructure (see above), actions are under way to improve the integration of the different services provided by the Agency — specifically the Operational Safety Review Team (OSART), Assessment of Safety Significant Events Team (ASSET) and Assessment of Safety Culture in Organizations Team (ASCOT) services. Attention is also being given to improving the co-ordination of the Agency's services with the work of other international organizations in similar areas, such as WANO's peer reviews.

An OSART mission visited Qinshan, China — a 300 MW(e) prototype PWR — in January 1997 at the request of the Chinese Government. Two OSART missions had visited Qinshan during construction of the reactor; this was the first during operation. The purpose of the mission — which included experts from nine Member States — was to review operating practices in the areas of management organization and administration, training and qualification, operations, maintenance, technical support, radiation protection, chemistry and emergency planning. The mission reported a commitment to improving operations, and specific recommendations were made in the areas of safety culture, communication, training, equipment maintenance and configuration management. Other OSART missions in 1997 visited Laguna Verde, Mexico, Yong Gwang, Republic of Korea, and Embalse, Argentina. Preparatory visits for four future

OSART missions were also carried out, and an OSART follow-up mission visited Ignalina, Lithuania.

At the request of the Bulgarian Government, an International Regulatory Review Team (IRRT), including experts from five Member States, visited Sofia, Bulgaria, in November 1997. The purpose of the mission was to review the effectiveness of the Committee for the Use of Atomic Energy for Peaceful Purposes and to exchange information concerning the role and responsibilities of the regulatory body, organization of the regulatory body, regulations and guides, the licensing process, requirements on applicants and licensees, review and assessment during the licensing process, regulatory inspection and enforcement, and radiation protection. As part of the mission, two members of the team visited Kozloduy nuclear power plant. Specific recommendations were made both on the regulation of operation and modernization at Kozloduy and on particular aspects of the Bulgarian regulatory regime in general. A pre-IRRT mission to Pakistan was also conducted during 1997.

In March 1997, a mission of the International Peer Review Service (IPERS) for probabilistic safety analysis (PSA) visited Taejon, Republic of Korea, to review the PSA for Ulchin Units 3 and 4. The PSA had been carried out by two Korean organizations, and a pre-review meeting had been held in October 1996 in Vienna to identify documentation requirements and to formulate preliminary lists of issues for the review proper. The main review was carried out in the form of a workshop involving participants from the Korean PSA team and the international mission team. The scope of the review included Level 1 and Level 2 PSAs and human reliability analysis but, because a separate review was addressing the treatment of external events, the IPERS review concentrated on the internal events PSA. Other IPERS missions concerned the HIFAR (High Flux Australian Reactor) at Lucas Heights, near Sydney, Australia — the first time IPERS has been applied to a research reactor PSA — and the nuclear power plants at Kozloduy (Units 3 and 4) in Bulgaria and Krško in Slovenia.

Other services provided in 1997 included four missions of the Integrated Safety Assessment of Research Reactors (INSARR) service, four ASSET peer review missions and seven ASSET training seminars on self assessment, one ASCOT seminar, and a total of 13 missions providing engineering safety review of site, structural and seismic safety issues — ten to reactor sites and three to other nuclear installations.

Radiological Assessments

The Agency has in recent years carried out a number of radiological assessments of areas with radioactive residues from accidents and from past practices such as nuclear weapon testing and radioactive waste disposal.

The International Arctic Seas Assessment Project (IASAP) was initiated in 1993 to investigate concerns over the potential health and environmental impacts of radioactive waste dumped in shallow waters of the Kara and Barents Seas. The findings of this project were described in the previous Nuclear Safety Review, and were submitted to the Contracting Parties of the Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter (the London Convention 1972). The full report will be published in early 1998.

In 1994, at the request of the Government of Kazakhstan, the Agency initiated a radiological assessment of the former nuclear test site near the city of Semipalatinsk. Following missions to the site and surrounding area, the expert group assembled by the Agency has prepared a report on the current radiological situation which was submitted to the Kazakh Government in 1997 and will be published early in 1998. The group concluded that further radiological assessment of the area surrounding the test site should not be regarded as a priority, although they recommended a hydrological study to investigate the future possibility of radionuclides from underground explosions appearing in drinking water supplies. Within the test site, the group concluded that most areas have little or no residual activity from the nuclear tests. However, two areas — the 'Ground Zero' and Lake Balapan areas — are heavily contaminated, and an assessment of the exposure of a critical group of site inhabitants who visit these areas on a daily basis indicates annual exposures of about 14 mSv, predominantly from external radiation. There are currently no permanent settlements within these areas; if permanent settlements were established there in the future, the estimated annual exposures would be an order of magnitude higher. Action is therefore considered necessary for the immediate areas around 'Ground Zero' and Lake Balapan, and restriction of public access to these areas is recommended as the most feasible and effective protective action.

In 1995, the Agency — at the request of the Government of the Marshall Islands — convened an expert group to review the radiological situation and prospects for resettlement at Bikini Atoll, which was used by the USA for atmospheric testing of nuclear weapons. The group concluded that there were feasible remedial measures that would allow Bikini to be reinhabited, and recommended a preferred strategy: removal of the soil from living areas, and treatment of the remaining soil with potassium based fertilizers to reduce the uptake by crops of radioactive isotopes of caesium. The group's report was presented to the Marshall Islands Government. At the request of the Government, and to provide further assurance to the Bikini people, an Agency mission visited the island in May 1997 and carried out independent monitoring of the environment and foodstuffs. The results obtained by the IAEA team were generally consistent with those from previous monitoring programmes that were used as a basis for the advisory group's assessment.

At the request of the French Government, the Agency initiated in 1996 an international assessment of the radiological situation at Mururoa and Fangataufa Atolls, the site of French nuclear weapon testing in the South Pacific. The studies were completed during 1997, and a report of the assessment is being prepared for publication in 1998. A summary of the principal findings can be found in GC(42)/INF/3.

Safety Related Research and Development

The Agency encourages research and development by supporting research contracts and agreements on a wide range of safety related subjects; at the end of 1997, there were almost 300 such contracts and agreements active, granted mostly under one of 24 Co-ordinated Research Projects (CRPs) on particular aspects of nuclear, radiation and waste safety. A complete list of the active CRPs is given in the IAEA's Annual Report.

PART III

NUCLEAR, RADIATION AND WASTE SAFETY IN MEMBER STATES

Information on significant achievements, developments and issues related to nuclear, radiation and waste safety was requested from Member States in November 1997. This review, prepared by the Agency Secretariat, summarizes a selection of the information provided by 27 Member States, namely Australia, Belarus, Belgium, Bulgaria, China, Finland, France, Germany, Greece, India, Indonesia, Ireland, Jordan, Malaysia, Norway, Peru, the Philippines, the Russian Federation, Slovakia, Slovenia, Spain, Sweden, The Former Yugoslav Republic of Macedonia, Tunisia, Turkey, the United Kingdom and the United States of America. The complete texts of the contributions received from these countries are reproduced in the Annex to the document.

SAFETY LEGISLATION

Several Member States reported progress on the development of fundamental national legislation governing the use of atomic energy, radiation sources and radioactive materials, to reflect current international standards:

- In Belarus, the Chamber of Representatives of the National Assembly adopted a law on "the national safety of the population", the scope of which includes safety regulation by the State, action to be taken in the event of a radiation accident, the responsibility of users of radiation sources for the consequences of their use, and the obligations and rights of citizens with regard to medical exposure and exposure to radon. A draft law on "the use of atomic energy and radiation protection" has been submitted to the Chamber of Representatives for consideration, and the Ministry of Health is close to completing a set of standards for nuclear safety.
- Germany reported that it is preparing extensive amendments to the Radiation Protection Ordinance to include the 1996 Euratom Basic Safety Standards. European Union Member States have until May 2000 to incorporate the Standards into national legislation.
- The Indonesian Government passed a new nuclear energy Act which, inter alia, ensures the independence of the regulatory body from bodies promoting nuclear energy and provides more detail than previous legislation in the areas of radioactive waste management and nuclear liability.
- A new Law on Peaceful Uses of Nuclear Energy was endorsed by the Government of Slovakia, and has been submitted to the Slovak Parliament. New regulations on the transport of nuclear material and radioactive waste, emergency planning and quality assurance are being prepared.

- A 'working version' of a law on protection from ionizing radiation and on nuclear safety has been prepared in The Former Yugoslav Republic of Macedonia. This will be submitted for comment to relevant institutions, and a draft law prepared.
- Tunisia's National Radiation Protection Centre (CNRP) reported on its work with the Ministry of Transport on the drafting of a law on the land transport of dangerous goods, including radioactive substances.

CONVENTIONS AND AGREEMENTS

Several Member States reported their involvement in the development of the Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management.

There was continued progress in Europe on a growing network of bilateral intergovernmental agreements on early notification of nuclear accidents, and on exchange of information and co-operation in the fields of nuclear safety and radiological protection. Finland reported that one such agreement, with Ukraine, was ratified by the Finnish Government in 1997.

STRUCTURAL AND ORGANIZATIONAL DEVELOPMENTS

Some Member States described structural or organizational changes to operators and/or regulators that were considered to be significant for safety:

- The formation was announced in September 1997 of the Australian Radiation Protection and Nuclear Safety Agency (ARPANSA). The new Agency will be the regulatory body for all radiation and nuclear activities carried out by Australian Federal Government agencies, including the operation of the two research reactors of the Australian Nuclear Science and Technology Organisation and the land transport of Federally-owned radioactive material. ARPANSA will also work with the States and Territories — which regulate other radiation and nuclear activities — to promote uniform policies and practices.
- Some sections of the 1994 Belgian law to create a Federal Nuclear Control Agency came into force in 1997, relating to the appointment of an administrative board and a Director General. The Agency will begin operation in 1998, its first task being to integrate the nuclear control services currently provided by different ministries.
- The decree on STUK (the Finnish Radiation and Nuclear Safety Authority) was revised to allow management changes.
- Responsibility for the safety of radioactive material shipments in France was transferred to the Directorate for the Safety of Nuclear Installations (DSIN);
- A Common Federal Programme for Nuclear and Radiation Safety in Russia is being developed by the Ministry for Atomic Energy and other federal bodies. This will be an

amalgamation of all existing programmes on nuclear and radiation safety in the Russian Federation.

- The former Yugoslav Republic of Macedonia is proposing to strengthen the role of the Sanitary and Health Inspectorate of the Department for Radiation Protection at the Republic Institute for Health Protection, Skopje, to act as the national regulatory body for radiation protection. A register of radiation sources is being prepared by this Inspectorate.

SAFETY ASSESSMENT

India reported on its use of computer codes to estimate the safety margins provided by BWR containment made of reinforced and prestressed concrete under a range of loads.

Level 1, level 2 and shutdown PSAs (probabilistic safety analyses) for the Krško NPP in Slovenia have been carried out at the request of the regulatory body, the first two performed by an IAEA IPERS mission and the third by an independent technical support organization. Measures are being taken to address issues identified by the analyses, particularly to address the risks associated with fire.

The Safety Analysis Report for the TR-2 research reactor at Cekmece in Turkey was reviewed and revised by the Turkish Atomic Energy Authority, in the light of current international standards and guidance.

The United States Nuclear Regulatory Commission (NRC) finalized guidance on the use of risk information from PSA in making changes to the design or operation of plants.

OPERATION — SAFETY REVIEWS AND UPGRADES

Safety reviews and upgrades were being carried out at nuclear facilities in several countries:

- The BR2 reactor, operated by the Belgian nuclear research organization CEN·SCK, was restarted after a two-year refurbishment programme which included upgrading of the protection system and inspection of the reactor vessel.
- A short term programme of measures to improve the safety of Kozloduy Units 1–4 in Bulgaria has been completed. Proposals for a longer term programme of measures to ensure the safety of these units for the rest of their operational lives have been submitted to the regulatory authority. Safety improvements were also made to Units 5 and 6.
- France reported on generic safety issues in EDF's series of 900 MW(e) and 1300 MW(e) PWRs. The problem with the 900 MW(e) stations — thermal cracking of auxiliary piping in the primary circuits — is being addressed by strict control programmes to ensure any cracking is detected quickly, and EDF now seems able to deal well with the problems in the 1300 MW(e) plants, namely anomalies in the operation of control rod clusters. A number of human related operational incidents were also reported.

- Following recent problems in other countries with BWR core shrouds cracking, India reported that examination of the core shroud at Tarapur NPP had indicated that there were no cracks. Nevertheless, a detailed analysis had been carried out to ensure that the safety margins were sufficient to cope adequately should cracks develop.

- A safety upgrading programme for Bohunice Units 1 and 2 in Slovakia is continuing. A short term safety improvement programme at Units 3 and 4 — requested by the regulatory body following a comprehensive review in 1995 — is about one-third complete. The most important category of safety upgrading measures at the Mochovce NPP is expected to be completed in time to allow fuel loading in mid-1998.

- Replacement steam generators for the Krško NPP in Slovenia are currently being manufactured, and evaluation of the safety aspects of the replacement operation has started.

- A programme to replace the steam generators at Almaraz and Ascó NPPs in Spain was completed. A two-year programme "Analysis of Operating Experience and Systems", to detect and correct possible design deficiencies in the Trillo NPP, was also completed in 1997.

- The Swedish spent fuel storage facility CLAB became the first non-reactor facility in Sweden to undergo an As Operated Safety Assessment Review (due after ten years of operation). The Swedish nuclear regulators SKI have indicated to licensees that they will require improvements in safety levels at NPPs if they are to license prolonged operation

- Periodic Safety Reviews were conducted by the United Kingdom Nuclear Installations Inspectorate on four NPPs. The Magnox NPPs at Calder Hall and Chapelcross have been operating for approximately 40 years, and the Advanced Gas-cooled Reactors (AGRs) at Hinkley Point B and Hunterston B were approaching 20 years of operation. In each case, the NII was satisfied that operation could continue for the next ten years; in the case of the older reactors, however, this is subject to annual review of pressure circuit integrity and the results of routine regulatory inspections.

- The United States Nuclear Regulatory Commission (NRC) has reviewed 74 individual plant examinations (IPEs) related to reactor safety and plant performance. The NRC will determine the necessary follow-up actions at the plants concerned, and a report of the findings will be published in 1998.

REGULATION

New or revised safety regulations and guides, on a range of subjects, were reported to have been published in several countries, for example:

- Bulgaria has issued a large number of regulations and guides, including basic rules and procedures for licensing and instructions for regulatory inspectors;

- China issued clearance levels for steel and aluminium, and standards for radioactive waste casks and for measuring radioactive waste and analysing leachate;
- Finland issued a number of new or revised regulatory guides on, inter alia, generators and electrical systems at NPPs and assessing dispersion of, and doses from, radioactive material released into the environment.
- Radiation safety regulations in Peru have been revised, bringing them into line with the ICRP's 1990 Recommendations and the International Basic Safety Standards.
- The Russian Federation's Ministry for Atomic Energy and Federal Nuclear and Radiation Safety Authority, along with other federal bodies, are preparing regulations on the safe transport of radioactive substances. Meanwhile, work is continuing to bring radiation safety standards in the Russian Federation into line with the International Basic Safety Standards.
- SKI, the Swedish nuclear regulatory body, issued draft regulations on Safety in Nuclear Facilities, containing requirements related to reactor safety, waste management, physical protection and on-site emergency management. SKI has also drafted a document defining the basis for future regulations on the disposal of spent fuel and nuclear waste. Both documents have been issued for review, with the intention that regulations will come into force at the beginning of 1999.
- The Turkish nuclear regulatory body TAEK has accelerated its preparation of regulations in the light of the Government's decision to proceed with a nuclear power programme. Three safety related Codes of Practice were issued in 1997, covering quality assurance and inspection, safe transport of radioactive materials, and the establishment of an Advisory Committee on Nuclear Safety, which will examine licence applications and proposed regulations and guidance.

Elsewhere, France reported a developing programme of inspector exchanges with counterparts in other countries, allowing inspectors to broaden their experience, and a new evaluation procedure to identify "experienced" inspectors for more delicate tasks. The Malaysian Atomic Energy Licensing Board has developed an interactive home page on the World Wide Web (http://www.jaring.my/aelb/) to enable users, including licensees, to communicate electronically with the Board. A final rule on licence renewal came into force in the USA in January 1997, and guidance for applicants is being developed by the NRC. The NRC is also working towards design certification for next-generation NPPs.

RADIATION EXPOSURE

Following expressions of concern in the media in France, the regulatory authorities requested information from the nuclear power plant operator EDF about the exposure of contract workers carrying out maintenance work on its plants. Investigations also continued into the question of whether the reprocessing plant operated by COGEMA at La Hague could be responsible for an increased incidence of leukaemia in the nearby north Cotentin area; a

Government-appointed committee has divided into two sub-committees to examine the epidemiological and radioecological information.

The National Radiological Protection Institute of Ireland published the results of the second phase of its National Radon Survey, covering 14 counties (the final phase — a further seven counties — is due for completion in 1998). Mean annual indoor radon concentrations for the second phase ranged from 63 to 147 Bq/m^3, with some values above 1000 Bq/m^3 recorded.

The Philippines has introduced a new thermoluminscence dosimetry (TLD) system for personnel monitoring, replacing the existing film-based system.

Spain reported that all individual worker doses in 1997 were well below the existing limit of 50 mSv, and only 71 workers (0.09% of those monitored) received more than 20 mSv, indicating good progress towards complying with the 20 mSv dose limit in the Euratom Directive on basic safety standards, which comes into force in 2000.

WASTE MANAGEMENT AND DECOMMISSIONING SAFETY

Existing waste storage and disposal facilities continued to operate without significant radiological incident, although shipments of high level waste (HLW) to the Gorleben storage facility in Germany continued to attract large scale (sometimes violent) demonstrations. Meanwhile, work continued in a number of countries to develop new disposal facilities for radioactive waste. For example:

- Licensing of the Konrad repository for non-heat-generating waste in Lower Saxony, Germany, is in an advanced state; approval for construction to proceed was expected in late 1997 or early 1998. Meanwhile, investigations continue into the potential suitability of the Gorleben salt dome for a spent fuel/high level waste repository.
- A construction licence for a repository for low and intermediate level waste at Himdalen, Norway, has been granted. Construction will be completed in 1998.

In Belarus, the upgrading and certification of 69 'Chernobyl repositories' — the near surface facilities used for the disposal of waste generated in the post-Chernobyl cleanup operation — was completed. A project to improve the safety of the Novi Han repository in Bulgaria has begun, with IAEA assistance.

In Belgium, the Government programme framework act of December 1997 gave the national waste management organization ONDRAF·NIRAS the task of establishing an inventory of all nuclear facilities and all sites containing radioactive substances. This task also includes estimating the decommissioning and cleanup costs for each site and assessing the adequacy of existing provisions to meet these costs. The inventory will be updated every five years.

The construction of liquid waste treatment facilities in the north-western and far eastern regions of the Russian Federation (expected to be commissioned early in 1998) will allow the practice of discharging liquid waste into open water bodies to be stopped.

Spent fuel from the decommissioning of the A-1 NPP in Slovakia is being sent to the Russian Federation under a newly revised agreement. Some of the spent WWER fuel stored on the Bohunice site came from reactors now in the Czech Republic; this fuel has now been transferred to Dukovany. A new drainage system was installed at the Mochovce near surface disposal facility, as required by the regulatory body.

Tunisia reported the organization of two training courses — one national and one regional — on radioactive waste management in hospitals.

In the USA, the NRC adopted radiation protection standards for licence termination at decommissioned facilities (see Part I). The NRC reached agreement with the Department of Energy on a performance-based approach to resolving issues of greatest safety significance for the proposed Yucca Mountain repository for high level waste, and on a number of specific methodological issues related to the safety assessment.

EMERGENCY PLANNING AND PREPAREDNESS

Belgium reported on progress in the development of infrastructure for the national emergency plan. A study carried out by CEN·SCK and the nuclear inspection agency AIB Vinçotte Nucléaire has identified the priority areas for the coming years.

Bulgaria commissioned a nationwide network of 26 gamma monitoring stations providing continuous measurement of dose rates. A specially equipped mobile radiometry and gamma spectrometry laboratory for use in the event of radiation emergencies was also commissioned.

The Philippines has completed a revision of its National Radiological Emergency and Preparedness Plan (RADPLAN). The RADPLAN arrangements are designed to be applicable to any type of radiological accident or emergency, including events outside the Philippines having a potential impact on the Philippine population or environment.

Slovenia's early warning radiation monitoring system — started in 1991 and subsequently upgraded — fed its first results into the international data exchange EURDEP at the EC's Joint Research Centre at Ispra, Italy.

PART IV

LOOKING AHEAD

This Section provides a brief discussion of some forthcoming events, and of some safety related issues that are likely to be prominent in the coming years. Many of the issues discussed in this section will be addressed further at an International Conference on Topical Issues in Nuclear, Radiation and Radioactive Waste Safety, to be held in Vienna from 31 August–4 September 1998.

CHRONIC EXPOSURES TO RADIATION

As reported in the previous Nuclear Safety Review, the pursuit of radiological criteria for the rehabilitation of areas affected by residual radioactivity from past practices, and for other chronic exposure situations, has raised a number of questions about the system of protection enshrined in the 1990 Recommendations of the International Commission on Radiological Protection (ICRP) and in the International Basic Safety Standards for Protection against Ionizing Radiation and for the Safety of Radiation Sources. For example, the principles for intervening in the event of a nuclear accident are well established, but the criteria for determining when an intervention situation can be considered to have returned to 'normal' are less well developed. These latter situations can often, quite reasonably, be compared to those in areas of high natural background radiation, where quite different standards seem to be applied. Another area of confusion arises from the fact that the existing system of protection concentrates largely on the increment of dose added by a practice or averted by an intervention, with relatively little attention being given to the total dose.

An Agency discussion document entitled "Application of Radiation Protection Principles to the Cleanup of Contaminated Areas — Interim Report for Comment" will be published early in 1998 and, as noted in Part II, a number of reports on radiological assessments of such areas are also due to be published in 1998. The ICRP has established a Task Group that is preparing a document covering the whole range of chronic exposure situations. Clearly this is an area where the principles will continue to develop in the coming years.

REGULATING LOW DOSES OF RADIATION

This issue is a matter of perennial interest, but has been particularly prominent of late. At one level, there has been renewed debate as to whether the fundamental basis for the regulation of low doses — the linear–no threshold (LNT) hypothesis — is valid. At another, the practical issues of managing low dose activities within the existing radiation protection framework continued to cause much discussion.

The LNT hypothesis of radiation risk, on which modern radiation protection philosophy is based, has come under attack in the past few years from both sides of the argument. Many individuals and some organizations — notably the French National Academy of Science and the US Health Physics Society — have argued in favour of a threshold below which individual doses should not be considered for radiation protection purposes. Some have argued this as a matter of principle, claiming radiobiological and/or epidemiological evidence that there are no adverse health effects from low doses; others suggest it as a pragmatic approach in the absence of direct evidence for such effects. Meanwhile, some researchers have interpreted experimental results and epidemiological findings as providing evidence that low doses of radiation are much more harmful than the LNT hypothesis implies. A number of mechanisms have been proposed by which this might occur, a recent example being the phenomenon of genomic instability. The renewed debate on the subject was evidenced by the number of national and international conferences and symposia at which the matter was discussed, culminating in an international conference in Seville, Spain in November sponsored by the IAEA and the World Health Organization, in co-operation with the United Nations Scientific Committee on the Effects of Atomic Radiation. Among other things, the Conference highlighted areas of radiobiological and epidemiological research that are likely to provide important new information on the effects of low doses in the coming years; there was particular optimism concerning epidemiological studies of workers and members of the public in and around the Mayak facility in the Russian Federation. From the evidence available at the present time, however, the LNT hypothesis continues to seem the most radiobiologically defensible basis for radiation protection recommendations. It is also a workable hypothesis that can underpin systems of regulation which, when applied reasonably, provide sound and sensible management of the risks from radiation.

A related issue, that of exclusion and exemption (along with the related concept of clearance) continued to attract much discussion, particularly in European Union countries, where the exemption levels specified in the Euratom Directive on Basic Safety Standards — which are numerically the same as those specified in the International Basic Safety Standards for Protection against Ionizing Radiation and for the Safety of Radiation Sources — will soon become mandatory (Member States have until May 2000 to implement the Directive in national legislation). A series of incidents in which slightly radioactive materials were transported from one State to another showed the potential for controversy. An international Specialists' Meeting at the IAEA in May highlighted many of the issues that remain to be resolved, the question of terminology being among the most prominent. International agreement on these issues is very important, as the purpose of exemption and clearance is to allow the free use of materials that do not warrant regulation. This cannot happen if material considered exempt in one State is regarded as a significant radiological hazard in another.

MANAGEMENT OF SAFETY AT NUCLEAR INSTALLATIONS

A number of the main events related to nuclear safety in 1997 suggested a common theme of deficiencies in the management of operational safety, even in States with long established nuclear programmes. The specific problems and their direct causes differed from case to case, but the underlying causes seemed to be consistently linked to the absence of key elements of safety culture. Different possible reasons for this have been postulated — complacency bred by past successes, cost cutting in a competitive energy market and authoritarian management, among others — but whatever the reasons there is significant room for improvement.

The principles of safety are well known and widely implemented. To go beyond the present level of nuclear safety, management of safety and safety culture will be the means for achieving progress. This means a commitment to safety from the top management down, a working environment in which communication is encouraged, staff concerns are listened to, and warning signs are noticed and acted upon. It also means constant vigilance to ensure that good safety performance is maintained, and is not taken for granted. Peer reviews can help in this regard, as can a continuing programme of self assessment. Regulatory inspection and enforcement are, of course, essential elements for monitoring safety at nuclear installations, but the primary responsibility for safety rests with the operating organization.

SAFETY OF RADIATION SOURCES AND SECURITY OF RADIOACTIVE MATERIALS

The possibility of illicit trafficking in nuclear materials has attracted great interest. While the interest started because of reports of nuclear material smuggling, it is also recognized that more mundane failures in the security of radiation sources and radioactive materials represent a substantial risk to human health. Incidents involving lost, abandoned or stolen radiation sources continue to occur.

Numerous incidents have occurred in recent years — particularly since 1992 — involving the illegal procurement and movement across national borders of nuclear materials and other radioactive sources. The vast majority of cases detected involved very small quantities of radioactive material, but in some incidents highly active sources emitting dangerous radiation levels were found. A frequent problem of particular importance is contamination of scrap metal due to careless or fraudulent disposal of industrial or medical radiation sources. Concerns remains as to whether larger scale trafficking, perhaps even involving weapon grade materials, is a real possibility. Many European States have taken action to improve their ability to prevent or detect such actions, and to ensure that any incidents that occur are handled in such a way that staff involved — principally customs and law enforcement officers — and the public are not put at risk.

Meanwhile, incidents continue to occur around the world in which radiation sources being used for medical, industrial and military applications are lost, abandoned, damaged, stolen, misused, etc; sometimes with serious or even fatal consequences. For example, Table II shows fatal radiation accidents — in nuclear facilities and non-nuclear industry, research and medicine

— reported in the past ten years; the number of accidents involving significant radiation exposure is several times greater. Improvements recommended and implemented on an ad hoc basis — typically after an incident has occurred — are being supplemented by a more systematic programme of improvements to regulatory control systems for sources (see discussion on Model Project "Upgrading Radiation and Waste Safety Infrastructure" in Part II). Nevertheless, further improvements and continued vigilance are needed to minimize the number and severity of such incidents.

An International Conference on the Safety of Radiation Sources and the Security of Radioactive Materials — co-sponsored by the IAEA, the European Commission, Interpol and the World Customs Organization — will be held in Dijon, France, from 14–18 September 1998, and will cover both of the areas of 'security' discussed above.

TABLE II. RECENT FATAL RADIATION ACCIDENTS (1987–1997)[a]

Year	Location	Type of source	Fatalities caused by radiation exposure		
			Workers	Public	Patients
1987	Goiânia, Brazil	Removed teletherapy source		4	
1989	San Salvador, El Salvador	Industrial sterilizer	1		
1990	Zaragoza, Spain	Radiotherapy accelerator			several[b]
1990	Soreq, Israel	Industrial sterilizer	1		
1991	Nesvizh, Belarus	Industrial sterilizer	1		
1992	USA	Brachytherapy			1
1994	Tammiku, Estonia	Source removed from waste repository		1	
1996	San José, Costa Rica	Radiotherapy			several[b]
1997	Sarov, Russian Federation	Critical assembly	1		

[a] In nuclear facilities and non-nuclear industry, research and medicine.

[b] The individuals affected in these cases were patients receiving radiotherapy for cancer, and therefore the number of deaths attributable to overexposure is not known. The numbers of patients overexposed were 26 (Zaragoza) and 115 (San José). In each case, overexposure is considered likely to have been a direct or major cause of several deaths.

COMMUNICATING NUCLEAR, RADIATION AND WASTE SAFETY ISSUES

Proponents and opponents of the use of nuclear technologies both devote considerable attention to communicating with decision-makers, opinion-formers, the media and the general public in order to convey their ‘message’. The communication challenge for regulatory authorities and their technical support organizations is somewhat less straightfoward. They have a responsibility to communicate with a wide range of audiences in such a way that unfounded fears are allayed, but real risks, concerns or problems are not understated. Furthermore, this needs to be achieved both on a routine, day-to-day basis and in circumstances of a real or perceived crisis. This need to provide accurate and timely information on nuclear, radiation, transport and waste safety issues, in a form that the relevant audience(s) can readily understand, applies to regulatory organizations in all States, not only those with nuclear power programmes.

To help authorities in this task, the Agency is preparing a document, provisionally entitled “Communication of Nuclear, Radiation, Transport and Waste Safety: A Practical Handbook”. It is intended that this document will serve as both a practical guide for regulators and the basis for material on safety related communication in training courses. It may also be used as a basis for future documents in this topic area.

THE CONVENTION ON NUCLEAR SAFETY — NATIONAL REPORTS, INTERNATIONAL SCRUTINY

An Organizational Meeting of the Contracting Parties to the Convention on Nuclear Safety is scheduled for 29 September–2 October 1998 in Vienna. The starting date of this meeting is also the deadline for Contracting Parties to submit national reports for discussion at the first Review Meeting of the Convention, which will begin on 12 April 1999. The international scrutiny of these detailed national reports is a novel and important feature of the Convention. Each report will describe the measures taken by the Contracting Party to fulfil the nuclear safety obligations set out in the text of the Convention. The national reports will be circulated to all of the Contracting Parties, who then have the opportunity to submit comments and questions. At the Review Meeting, each report — along with comments and questions submitted in advance by other Contracting Parties — will be reviewed by one of five Country Groups, who will then report their conclusions back to a plenary session of the Meeting. The main tasks of the Organizational Meeting will include the establishment of these Country Groups — by a pseudo-random process designed to ensure that each Group has a mixture of nuclear experience — and the selection of co-ordinators, rapporteurs and working language for each Group.

Many of the Contracting Parties are known to already be in the process of preparing national reports, and some regional groups have emerged, exchanging views and experience on the preparation process.

The meeting of Contracting Parties to the Convention on Nuclear Safety will result in a degree of transparency in safety matters that will be substantially higher than has existed in the past. While the conclusion is likely to be that, in general, nuclear safety has improved worldwide, the Parties will probably focus on some areas that require further attention.

Contracting Parties are likely to address situations where the independence of regulatory authorities is in question or the authorities have not effectively discharged their licensing duties. Openness in the exchange of information on safety issues and operating events is also a likely area for discussion. Contracting Parties that have not been open to international reviews, will be faced with increased scepticism about the safety of their nuclear activities. Overall, an increase in international activities and transparency will be necessary if concerns about the level of safety actually being achieved are to be counteracted.

TRANSBOUNDARY MOVEMENT OF RADIOACTIVE MATERIALS

As was noted in Part I the transport of radioactive materials, and radioactive waste in particular, has attracted considerable attention. Shipments that had been operating routinely in the past have been increasingly highlighted by pressure groups, and have attracted increased expressions of concern from some States along the route. Some have raised their concerns at international forums, such as the International Maritime Organization, the Diplomatic Conference on the Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management, and the IAEA's General Conference and Board of

Governors. Both the Diplomatic Conference and the IAEA General Conference adopted resolutions on the issue; the latter requested the Agency "to prepare ... a report on legally binding and non-binding international instruments and regulations concerning the safe transport of radioactive materials and their implementation". The IAEA Secretariat has begun work on such a report, and is also taking the lead — as part of an informal working group with the IMO and the United Nations Environment Programme (UNEP) — in carrying out a literature review on the potential consequences of severe maritime accident scenarios involving shipments of irradiated nuclear fuel, high level waste and plutonium.

Some States have raised questions of safety and emergency preparedness; for example, a Joint Declaration on the Transport of Radioactive Waste issued by the Governments of Argentina, Brazil, Chile and Uruguay (reproduced in the Attachment to INFCIRC/533) declared, inter alia, "their grave concern at the risks associated with the transit through the region [of the Cape Horn route] of ships transporting radioactive waste". However, the focus of concerns has often been more on issues such as prior notification of shipments and consent of transited States. The present indications are that these issues must be resolved internationally so that the rights of shipping States and transit States reach an appropriate balance.

ECONOMIC DEREGULATION OF ENERGY MARKETS

National energy markets are increasingly being opened up to competition between generators, bringing a greater degree of privatization of operating organizations. In some States, this is already a reality, and there are strong indications that it will spread to many others in the near future. This process imposes new pressures on operators to cut costs — and often, therefore, to cut staff numbers — and to find more efficient working practices. It is incumbent on regulators and operators alike to ensure that the measures through which nuclear operators strive to compete do not lead to safety being compromised. As indicated in Part I, regulators are increasingly aware that this is an issue that needs to be addressed, and that vigilance is needed to detect, and if necessary reverse, any negative trends in safety performance.

ANNEX

NUCLEAR, RADIATION AND WASTE SAFETY IN MEMBER STATES

In November 1997, Member States were requested to provide information on significant national achievements, developments and issues related to nuclear, radiation and waste safety during 1997. A summary prepared by the Secretariat, of the contributions received is included in Part III of the Nuclear Safety Review for the Year 1997. The complete texts of the contributions received (with minimal editing by the Secretariat[1]) are reproduced below for the information of Member States. Two Member States — Greece and Jordan — provided replies to the Agency's request for information to the effect that they had no relevant developments to report.

AUSTRALIA

New Regulatory Agency for Australia

In September 1997 the Australian Federal Government announced the formation of a new regulatory agency. The new agency, to be called the Australian Radiation Protection and Nuclear Safety Agency (ARPANSA), will regulate all radiation and nuclear activities carried on by the Australian Federal Government agencies, many of which are not currently subject to formal regulation. The activities to come under the jurisdiction of the new agency include the two research reactors owned and operated by the Australian Nuclear Science and Technology Organisation and associated facilities, as well as radiation activities of other Federal agencies. ARPANSA will also be the competent authority for the land transport of Federally owned radioactive material. In addition, the agency will work with the States and Territories to promote uniform radiation health and nuclear safety policies and practices within all Australian jurisdictions.

Abnormal Operating Events at Reactor Facilities

The applicable reactor facilities are a 10 MW materials testing reactor (High Flux Australian Reactor, or HIFAR) used for research and isotope production and a 100 kW university training reactor which is permanently shut down and is to be decommissioned. There were no abnormal operating events rated at Level 2 or above on the International Nuclear Event Scale (INES) at these facilities. Although Australia has not formally adopted the INES, it has been in trial use for some years for events at Australian reactors.

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[1] The designations used in text provided by contributors have been reproduced as received. The designations employed do not imply the expression of any opinion whatsoever on the part of the IAEA Secretariat concerning the legal status of any country, territory or area, or of its authorities.

Probabilistic Safety Analysis of the Australian High Flux Reactor

A level 1+ probabilistic safety assessment and residual life study of HIFAR has been undertaken which includes an assessment of components that might be life limiting. It also set out to identify components that perform functions critical to the operation or safety of the reactor but which it is impractical to replace or repair. The report of the assessment is to be released in 1998.

Replacement Research Reactor for Australia

In September 1997 the Australian Federal Government announced the construction of a new 15–20 MW research reactor to replace the ageing 10 MW HIFAR which first went critical in 1958. It is planned to commission the reactor in 2005 and shut down and decommission the existing reactor. The state-of-the-art facility will produce diagnostic and therapeutic radiopharmaceuticals, and support scientific research and higher education through improved access to a modern, versatile neutron source. The new reactor will be regulated by ARPANSA.

BELARUS

Work has been completed on the upgrading and certification of 69 waste disposal sites used for contaminated material from the initial cleanup period after the Chernobyl accident. The radionuclide composition, the total activity and the volume of the waste have been determined.

The Belarus Ministry of Health is putting the finishing touches to a set of standards for nuclear safety. A joint Belarus–Russian working group has begun reviewing the basic public health regulations for ensuring radiation safety in the Republic of Belarus.

In 1997, the Chamber of Representatives of the Republic of Belarus's National Assembly adopted a law on "the national safety of the population" whose scope includes:

- regulation by the State;
- action to be taken in the event of a radiation accident;
- material responsibility of the user of an ionizing radiation source for the consequences of the utilization of that source;
- obligations and rights of citizens undergoing irradiation for medical purposes; and
- obligations and rights of citizens exposed to radon in the natural radiation background.

A draft law on "the use of atomic energy and radiation protection" has been submitted to the Chamber of Representatives of the National Assembly for possible consideration during the first quarter of 1998.

BELGIUM

In 1997 some sections of the April 1994 law creating the Federal Nuclear Control Agency were brought into force. They relate to the appointment of the members of the Administrative Board and the Director General. The Agency will therefore be able to go into operation in 1998, its first task being to integrate the nuclear control services in various ministries. Collaboration between the Agency and the current competent bodies will also be specified.

The establishment of the infrastructure for the national emergency plan is continuing; a study carried out by CEN·SCK (nuclear research centre) and AIB Vinçotte Nucléaire (AVN, the Belgian nuclear inspection agency) has identified the priority needs for the coming years. Stable iodine tablets will be distributed to populations in the vicinity of nuclear power plants in 1998.

Two years after being shut down for refurbishment the BR2 reactor operated by CEN·SCK was restarted in April 1997. During the shutdown the beryllium matrix was loaded, a comprehensive inspection of the reactor vessel was conducted and a great deal of equipment, including the protection system, has been upgraded. The reactor was started up again without any particular difficulties.

In response to a world shortage, the Institute for Radioisotopes (IRE) has increased its production of molybdenum-99 by 50%. Certain operational procedures have had to be adapted.

For the Doel and Tihange nuclear power plants, 1997 was a record production year, with more than 46 TWh being generated.

At the Tihange site, the spent fuel store has gone into service. Its total capacity exceeds 4500 fuel assemblies.

As a result of the gradual deformation of fuel elements, a phenomenon observed only at Doel-4 and Tihange-3 which use 14-foot high assemblies, these two units have had to proceed to refuelling ahead of schedule because the deformation of the assemblies was giving rise to increased insertion time for the control rods. The situation will be corrected gradually by loading assemblies with thickened guide tubes.

Investigations and preparatory work have started at Tihange-3 on replacement of the steam generators, which is due to take place in 1998.

Discussions have been held between the various operators, the AVN and ONDRAF (the national organization for radioactive waste and fissile material) to compare practices with respect to the release of potentially radioactive material. Ultimately it will be possible to submit a unified procedure to the authorities for their approval.

In 1997, under the Phare and Tacis programmes for nuclear assistance to the countries of eastern European and the former Soviet Union, the AVN continued its collaboration with the safety authorities of a number of countries (Armenia, Bulgaria, Croatia, Hungary, Romania, Russia, Slovakia, Slovenia and Ukraine) providing assistance particularly with regard to inspection methodologies, radiation protection, probabilistic safety studies, validation of safety software programmes, feedback, and steam generator corrosion problems.

The AVN also provides advice to the European Commission (DG-XI and the Phare–Tacis Expert Group to the DG-IA) for the follow up of these programmes and represents Belgium on the Regulatory Assistance Management and CONCERT working groups.

Within the framework of new generation reactor studies, the AVN co-ordinates the analyses and evaluations of the "European Utilities Requirements Documents" prepared by various safety authorities in European countries and is the technical leader of a study subsidized by the European Community on advanced reactor safety principles.

It is also an active participant in international bodies, including the IAEA's NUSSAC (Nuclear Safety Standards Advisory Committee), which supervises the preparation of safety rules and guidelines within the NUSS programme.

The AVN is also continuing its R&D activities by participating in the OECD's Halden and Rasplav projects, collaborating with the French Institute for Radiation Protection and Nuclear Safety (IPSN) on the utilization of the CATHARE and ICARE codes, by making a major contribution to the preparation of safety guidelines on quality assurance and software validation, and by using probabilistic studies to analyse incidents that have occurred at nuclear facilities.

Sphere of competence of ONDRAF

The Government programme framework act of 12 December 1997 relating to various provisions (Moniteur Belge[2] dated 18 December 1997) confers on ONDRAF the mission of establishing an inventory of all nuclear facilities and all sites containing radioactive substances. This mission includes the establishment of a list of the location and status of all nuclear facilities and all sites containing radioactive substances, an estimate of their decommissioning and clean-up costs, assessment of the availability and adequacy of provisions for financing such operations in future or already under way, and updating of this inventory once every five years.

BULGARIA

Safety improvements of Kozloduy NPP units I–IV with WWER-440/230 reactors

In 1997, the third stage of the shortened three-stage programme for improvement of the operational safety and reliability of Kozloduy units I–IV has been completed with the following important improvements in the technological systems of the units:

- Installation of quick acting main steam isolation valves (MSIVs) on main steam pipelines at units II and IV;

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[2] Translator's note: Official law gazette of Belgium.

- Replacement of the steam generators and safety valves at unit IV;
- Reconstruction of elevation 14.7 in turbine hall including seismic reinforcement of steam lines and equipment;
- Installation of additional safety valves on primary circuit, combined with special computerized control in order to protect the pressure vessel against cold overpressurization and applying the procedure 'feed and bleed' at Units II, III and IV;
- New neutron flux control system of the reactor core at units II and IV;
- Installation of generator breakers at unit IV; and
- Implementation of safety parameters display system (SPDS) for unit IV (the implementation of the: SPDS for unit III is in progress).

Besides this programme, other modifications were made such as:

- Building of second fire protection pump station; and
- Implementation of an additional feedwater system for the steam generators of units III and IV (forthcoming for units I and II).

In parallel, studies on safety aspects were performed such as:

- Evaluation of' reactor pressure vessel material properties on units I and II including taking samples from RPV metal and study of the embrittlement by reirradiation of samples;
- Justifying the applicability of the 'leak before break' concept for the main primary pipelines;
- Qualification of the equipment for safe shutdown of the reactor (including seismic impact);
- Assessment of the rest lifetime of the equipment; and
- PSA level 1 for units I–IV.

The first draft of the "Complex Programme for the Enhancement of the Safety of Kozloduy NPP units I-IV ensuring their Operation for the remaining Lifetime" was elaborated and submitted for .assessment by the Nuclear Safety Regulatory Authority. The aim of the Programme is the realization of technical measures applicable to the specific characteristics of the Kozloduy NPP that are justifiable from economic point of view. They will also be directed to the elimination of the non-conformities of the units regarding the requirements of the current regulatory and technical documentation and to ensuring the safe operation for the remaining lifetime of the main facilities.

Safety improvements of Kozloduy NPP units V and VI with WWER-1000/320 reactors

At units V and VI some improvements were implemented to increase reliability and safety. Some of the major improvements are related to the design changes concerning the reliability of control rod insertion.

Other important improvements are related to design changes in the steam generators, emergency cooling, as well as transition from a two to a three year fuel cycle and replacement of the neutron flux control system with current technology.

In the spring of 1997, framework agreements between the National Electric Company and the European Consortium - Westinghouse were concluded for implementation of the upgrading programme for the units. Concerning the licensing of the programme, the Committee on the Use of Atomic Energy for Peaceful Purposes (CUAEPP) has requested assistance from the West European experts' organization through the European Commission.

Radioactive waste

In February 1997, the Phare project "Management of Radioactive Waste in Bulgaria" was completed. As a result of this project, recommendations were made on the safe storage and disposal of the radioactive waste (RAW) generated by the operation of the Kozloduy NPP as well as by the isotope applications in industry, medicine, agriculture, etc.

A plant for RAW treatment is under construction on the Kozloduy NPP site, and is expected to be finished in 1999.

A project for improving the safety of Novi Han RAW repository has started with IAEA technical assistance.

Spent fuel

An approach has been approved for solving the problems of spent fuel, by simultaneous implementation of activities to improve the safety of the existing facilities and development of optimum versions for long term decisions.

Technical projects for different versions and types of dry spent fuel storage were developed, which are being assessed from the point of view of choosing the optimum solution.

Radiation protection

The National Automatic Information System for continuous measurement of the background gamma radiation was commissioned in 1997. It consists of 26 monitoring stations all over the territory of Bulgaria.

The Central Control Board for management of the system is installed in the National Ecology Centre within the Ministry of Environment and Waters (MEW), including two additional terminals in the CUAEPP and the Civil Protection Department for continuous surveillance of radiation situation in the country.

For the objectives of emergency planning and preparedness in case of radiation accidents, the MEW commissioned a specially equipped mobile radiometric and gamma spectrometric laboratory for radiation monitoring which was supplied under the European Commission's Phare Programme.

Regulations and guides

The following regulations and guides have been adopted in 1997:

1. Guide on quality assurance in the NPP operation. This formulates the policy and determines the main requirements, principles, objectives and responsibilities related to the quality assurance in the NPP operation;
2. Guide on periodical testing and checking of the systems, facilities and components of the NPP important for nuclear safety. This determines the main issues and requirements related to the periodical testing and checking of the systems important for nuclear safety aimed at specifying their conformity to the design and technological regulations as well as to the permanent control of the normal operation of the NPP;
3. Guide on NPP personnel qualification. This presents the methods and mechanisms for carrying out control over the NPP personnel qualification as well as recommendations for allocation of the competencies on professional training between the relevant levels and bodies at the NPP, nuclear electricity company and CUAEPP;
4. Guide on reporting of operational data to the CUAEPP. This determines the necessary operational data on the status of the nuclear facility which should be presented to the CUAEPP at a fixed time, order and type of documentation.
5. Manual on management of the ISUAE activities. This determines the policy, objectives and practice for ensuring effective and qualified control on maintenance and enhancement of the safety level at the nuclear facilities and other sources of ionizing radiation, as well as for protection of the personnel and the population from ionizing radiation.
6. Basic rules and procedure for licence issuance by the ISUAE.
7. Instruction for implementation of operational control by ISUAE site inspectors. This defines the order for implementation and accountancy of operational control over the nuclear, radiation and technical safety in NPP operation.
8. Instruction for operational non-destructive testing. This defines the main requirements for the order, methods, volume and frequency of the testing of the metal of equipment and pipelines after their commissioning in regular operation.
9. Guide on topical inspections on radiation protection at nuclear facilities. This defines the main requirements for the order, methods, volume and periodicity of the control over radiation protection at the nuclear facilities.
10. Guide for use of the probabilistic safety analyses by the ISUAE. This defines the requirements for use of the PSA in the licensing proofs for design, construction and operation of nuclear facilities aimed at ensuring maximum reliability in implementing safety functions.
11. Instruction for the requirements to the scope and contents of the Technical justification of safety for temporary dry storage of spent fuel in containers.
12. Instruction for issuance of prescriptions by the ISUAE inspectors. This defines the rights and the obligations of the inspectors when giving prescriptions in conformity with their qualification and title position as well the order of issuing prescriptions.

13. Instruction for periodical and systematic safety assessment of the NPP operation. This defines the necessary documentation, conditions, order and terms for carrying out periodical and systematic safety assessment of the NPP operation.
14. Guide for licensing of full-scale NPP simulators. This indicates the main stages of the licensing process, documentation which is required by the training organization as well as the basic criteria for assessment of the simulator and the training programmes.
15. Instruction for the ISUAE inspection activity. This defines the integrated procedure for carrying out the inspection activities by the inspectors, for development and evaluation of the annual plan for the control activity of the CUAEPP, for elaboration of the documentation of the inspection activity and analyses of the ISUAE inspection activity.

CHINA

Radioactive waste management

The following Regulations and Standards on radioactive wastes management were revised or prepared in 1997:

- Radioactive waste cask — Steel container;
- Clearance levels for steel and aluminium; and
- Activity measurement of radioactive waste and analysis of radioactive leaching solution.

Progress achieved in the construction of repositories for low and intermediate level waste (L/ILW) included the following:

- The north-west China L/IL W repository, as completed, is prepared for completion acceptance and disposal of radioactive wastes. Operation documents, including operating and management regulations, QA programme, and regulatory procedures, were reviewed by experts convened by competent authorities. Training courses were held for operating personnel;
- An environmental impact report for the construction phase of the Guangdong L/ILW repository in south China was reviewed by the National Environmental Protection Agency. Operating and management regulations, QA programme, and regulatory procedures were drafted; and
- Provisional management rules for L/ILW disposal were under expert review and will be issued in 1998 for execution.

Nuclear safety regulation

Regulatory practices

- The National Nuclear Safety Administration (NNSA) issued the Construction Permit to Ling Ao NPP, 12 May 1997;
- Qinshan Nuclear Power Company submitted the application and the Preliminary Safety Analysis Report for Qinshan III NPP (CANDU-6) to NNSA, 27 May 1997;
- The Preparatory Office of Lianyungang Nuclear Power Project submitted the Engineering Feasibility Study Report for Lianyungang NPP-1 to NNSA, 17 July 1997. The NNSA issued the Review Comments on Siting of Lianyungang NPP, 25 September 1997;
- The NNSA approved the re-start of the Minjiang Test Reactor, 14 September 1997;
- The NNSA issued the Partial Construction Permit for the Pilot Reprocessing Plant, 3 July 1997;
- The NNSA examined and approved the License on Civil Nuclear Material to the China Institute of Atomic Energy, 18 April 1997; and
- The NNSA examined and approved the License on Civil Nuclear Material to the China Institute of Nuclear Power, 2 April 1997.

The safety regulations, codes and guides promulgated in 1997 were as follows:

- HAF 0800: Code on the Safety Regulation and Management of Radioactive Wastes.

The safety regulations, codes and guides to be promulgated were as follows:

- Rules for the Implementation of the Emergency Management Regulations for Nuclear Accidents at Nuclear Power Plant, Part One: Inspection and Regulation on Emergency Preparedness and Response of Operational Organizations of Nuclear Power Plants;
- Safety Guide, Safety Design of Storage Facilities for Spent Fuel
- Safety Guide, Safety Operation of Storage Facilities for Spent Fuel
- Safety Guide, Safety Review of Storage Facilities for Spent Fuel
- Safety Guide, Classification of Radioactive Waste
- Safety Guide, Siting of Nuclear Surface Disposal Facilities
- Safety Guide, Siting of Geological Facilities
- Safety Guide, Nuclear Materials Accounting and Balance for the Conversion of Low-Enriched Uranium and Nuclear Fuel Element Fabrication

FINLAND

Enactment or revision of safety related laws or regulations during 1997

The legislative situation in Finland has been quite stable over the recent years. The nuclear legislation remained unchanged during 1997. The only revisions at the legislative level were the following:

- Radiation Act section 72 has been withdrawn. The section dealt with the extra vacation of persons who are liable to be occupationally exposed to radiation in a hospital or health centre;
- Decree on STUK (Radiation and Nuclear Safety Authority in Finland) was totally renewed to enable the reorganization of STUK and some upper management changes;
- The new agreement between Finland and Ukraine on early notification of a nuclear accident and on the exchange of information on nuclear and radiation safety matters was ratified by a decree; and
- The regulation on the planning of the protective actions needed and information of public in case of radiation hazard was issued by she Ministry of Internal Affairs.

The regulatory guides (YVL Guides) issued by STUK during 1997 were as follows:

- YVL 3.1 Construction plan for nuclear facility pressure vessels, 27 May 1997;
- YVL 5.I Nuclear power plant diesel generators and their auxiliary systems, 23 January 1997;
- YVL 5.2 Nuclear power plant electrical systems: and equipment, 23 January 1997;
- YVL 7.2 Evaluation of population doses in the vicinity of a nuclear power plant, 23 January 1997;
- YVL 7.3 Evaluation of models for calculating the dispersion of radioactive substances from nuclear power plants, 23 January 1997; and
- YVL 7.4 Nuclear power plant emergency response arrangements, 23 January 1997.

No radiation safety guides. (ST Guides) were issued 1997.

FRANCE

In the nuclear safety field, several events made the front page in the media during the course of the year, which no doubt indicates a renewed sensitivity on the part of the French public to nuclear safety problems: work conditions of the subcontractor staff of Electricité de France (EDF), the development of fast reactors, the radiological impact of the COGEMA (Compagnie Générale des Matières nucléaires) plant at La Hague, radioactive waste management, iodine distribution in the vicinity of nuclear power plants. Other events have had less impact but require ongoing in-depth attention: nuclear material accountancy problems at the Commissariat à l'Energie Atomique (CEA), incidents of a generic nature affecting EDF plants. 1997 also saw the launch of the 1450 MW(e) plant series and further preparations for the reactors of the future. Finally, the French safety authority (Directorate for the Safety of Nuclear Installations, or DSIN), apart from taking responsibility for another activity sector — control of the safety of radioactive material shipments — also launched several initiatives to improve still further the quality of work and control thereof.

Power reactor safety

The working conditions of the staff to whom EDF periodically subcontracts a large part of the annual maintenance work for its plants became the subject of televised reports and discussions among the general public. This problem stands at the edge of the DSIN's field of competence since it relates essentially to the application of the Work Code and control of personal dosimetry; however, it can have real consequences in safety terms. The French safety authority decided to involve itself in this matter, in conjunction with the administrations which bear direct responsibility, and to request EDF to provide detailed information on how the annual planned shutdowns are run in this respect.

The development of the existing fast reactors in France, the Phénix and Superphénix, has been the subject of major and impassioned debate. As regards the Superphénix, this year was marked by the annulment by the Council of State of its decree authorizing a restart, and later by the announcement by the new Government of its decision to close it permanently. These two decisions were not dictated by safety considerations; however, the second has prompted the DSIN and its technical support unit (the Institute for Radiation Protection and Nuclear Safety, IPSN) to address the problems of dismantling the Superphénix, which had not been planned for the so immediate future, and which raises not insignificant safety issues as regards the unloading of the fuel and then of the sodium.

As for the Phénix, the information provided by the Commissariat à l'Energie Atomique finally prompted the safety authority to approve a recommencement of power operation, though some repair work remains to be done at the end of the first of the forthcoming operating cycles.

There have been several generic problems affecting plants operated by EDF. The operator remains very heedful of the anomalies in the functioning of the control rod clusters in the 1300 MW(e) series and now seems able to deal with them well. More recently, cracking of some auxiliary piping in the primary circuit as a result of thermal cycling has been detected in reactor 1 at Dampierre and this affects several reactors in the 900 MW(e) series; since these cracks can develop swiftly (they can start and spread through the whole wall thickness in less than one cycle) there is a need for a strict control programme. Finally, the discovery of a highly abnormal leakage rate at the end of the year in the containment of reactor 1 at Flamanville has led to an inquiry into the origin of this phenomenon and the possible consequences for plant operating lifetimes.

The 1450 MW(e) series of EDF reactors is being commissioned. The two reactors at Chooz B were brought up to power during the year under normal conditions. Reactor 1 at Civaux followed right at the end of 1997, after the regulatory authorizations had been granted and, in particular, the radioactive discharge authorization (September 1997).

Moreover, work has continued throughout the year — in conjunction with the German safety authority — on the future EPR (European Pressurized Reactor) for which the detailed preliminary design was submitted by the Franco-German designer, Nuclear Power International (NPI), for approval, which might be granted towards the end of 1998.

Safety of nuclear fuel reprocessing

The COGEMA facility at La Hague has been the subject of several inquiries during the year, whether into the possibility that it might be responsible for the incidence of leukaemia in north Cotentin following an epidemiological study, or into the vicissitudes of the descaling operation on its undersea discharge piping which was found to be radioactive when it was uncovered during a particularly low tide. With regard to the first issue, a committee set up by the Government, and subsequently split into two sub-committees dealing respectively with epidemiology and radioecology, will be continuing its work following the initial reassuring results. With regard to the second, the goal of the descaling operation has finally been achieved, resulting in a major reduction in the radioactivity of the discharge conduit; however, a final cleaning of the end zone of the conduit — where there was slight incidental pollution during the operation — still remains to be done. For the safety authority, the real problems of the La Hague site lie elsewhere. The revision of the decrees authorizing its setting up and those authorizing the discharges from the site, which could not be done in 1997, must be brought to a successful conclusion in 1998.

Safe management of radioactive waste

In 1997, the radioactive waste management area saw the launching of three public inquiries into requests for the authorization, setting up and operation of underground laboratories to study underground waste storage at three sites. Despite some local opposition, the views of the inquiry commissions and the Prefects concerned have been unanimously favourable, as also was the technical opinion of the standing expert group consulted in parallel by the DSIN. The DSIN, in a report issued at the beginning of December, indicated that two sites seemed suitable: the east site and the one in the Gard department. It is now up to the Government to take a decision as to the number and setting up of the laboratories to be authorized. The importance which has rightly been attached to this problem of underground laboratories — which relates to the management of long-lived highly radioactive waste — should not be allowed to detract attention from the continuing work on low-level waste for which a surface storage design has been elaborated which has been presented to those persons and associations which have the greatest interest in this matter. This should become a concrete project in 1998.

Safety of research activities

In addition to the problems mentioned above, which have been widely publicized in the media, other events have occurred during the course of 1997 which have a bearing on nuclear safety. First and foremost, there were the anomalies which were discovered in the nuclear material accounting which the CEA is obliged to conduct like any other operator and which, in its case, is particularly complex owing to the diversity of its research activities:

- Two fragments of a fuel pencil (containing 24 g of plutonium oxide and 200 g of depleted uranium oxide) could not be located;

- In one laboratory, 170 g of plutonium were present in a batch of oxide which was supposed to contain only natural uranium; and

— In another laboratory, 10 g plutonium were present in a batch which was supposed to contain only medium-enriched uranium.

All these are instances of insufficiently strict control of material accountancy, which is an essential feature of international non-proliferation safeguards but is also an important means of preventing the risk of an accidental critical excursion. The Commissariat à l'Energie Atomique, fully aware of what was at stake, reacted with vigour and implemented measures with a view to swiftly regaining a "zero level" for nuclear material holdings, and to preventing the accumulation of radioactive objects which were of no real interest.

Safe transport of radioactive material

The safety authority has taken on a new activity — control of the safe transport of radioactive material — which was formerly the responsibility of the Ministry of Transport. The shipwreck of the "Carla" off the Azores, which was carrying radioactive sources which were being shipped by their French manufacturer, has underlined again the safety risks of this type of activity, even though the health impact of this accident was in the end insignificant.

Preparation for crisis management

The generalized preventive distribution of stable iodine compounds in the vicinity of plants, to be used in the event of a nuclear accident to prevent cancers of the thyroid caused by saturation of that organ, has elicited several articles in the local press. This action was not prompted by any new perceived risk but anticipates, prior to the event, a distribution operation which was in any case planned in the event of an accident. The operation, which involved the Ministries of Health, the Interior, National Education and Defence, was carried out by the General Secretariat of the Interministerial Committee for Nuclear Safety (SGCSIN). Apart from its operational interest, this initiative has the advantage of involving local representatives and the public in the planning for, and management of a possible accident; it was, moreover, remarkably well received by those involved.

Human factor

Incidents relating not to the reliability of equipment but the behaviour of individuals are no less worthy of interest. Thus, at reactor 1 at Paluel, an erroneous neutron parameter setting which could have affected safe operation under accident conditions was deliberately not corrected on two occasions and the error knowingly concealed from the hierarchy.

Similarly, in the Orsay Laboratory for the Utilization of Electromagnetic Radiation (LURE), a lock preventing access to the particle accelerator while it is in operation was voluntarily removed by the experimenters and then left in an unmonitored state.

Incidents of this kind remind us — if there were any need to do so — of the importance of the human factor in the operation of nuclear facilities.

Developments in the safety authority

During 1997, exchanges of inspectors with foreign counterparts of the DSIN were developed and, in particular, long-term exchanges. Thus, some inspectors left to join certain foreign safety authorities for a period of around three years.

Finally, as regards organization of quality and the control thereof inside the safety authority, several initiatives were launched in 1997. An evaluation procedure for inspectors was introduced enabling us to determine, according to a precise frame of reference, which inspectors are "experienced" and should therefore be given the more delicate tasks to perform. The review of the distribution of the tasks of the nuclear safety authority between the national and regional level has continued and should soon result in concrete decisions leading to decentralization and upgrading of regional responsibilities.

Conclusion

These, briefly, are the main highlights in the nuclear safety area in France for 1997; their number and diversity will ensure that in-depth work will continue to be carried out in the years to come, as previously. However, these highlights, however important they may be, should not be allowed to mask the daily tasks — often less striking — which safety staff carry out on a regular basis: the operator, the safety authority and their support staff.

GERMANY

In 1996 the gross electricity production of Germany nuclear power plants (NPP) amounted to 161.7 TWh, with an increase of 4.9% compared to 1995 (154.1 TWh). This corresponds to a nuclear share in the public electricity production of 33.2%. From January until June 1997 the gross electricity production was 87.4 TWh, with an increase of 12% compared to the first half-year of 1996 (77 TWh).

At present there are 19 nuclear power reactors (13 PWR and 8 BWR) in operation with a gross electrical capacity of 22.2 GW(e).

Since 1988 the Mülheim-Kärlich NPP (KMK, a PWR of 1302 MW(e)) has been out of operation due to continuing court procedures. A final decision on the possible restart to the KMK NPP is expected by the federal administration court in 1998.

The German NPPs have continued safe operation. A total of 137 events according to the National Reporting Criteria were reported in 1996. Out of these, 131 events were rated as INES level 0, and six events were rated as INES level 1. From January until September 1997, a total number of 77 events were reported (74 events rated as INES level 0, three events as INES level 1).

The State of Bavaria granted the first and the second partial construction licenses for the new high flux research reactor FRMII at Garching near Munich on 9 April 1996 and 13 October 1997, respectively.

Germany ratified the Convention on Nuclear Safety on 20 January 1997 and became a contracting party on 20 April 1997. On 1 October 1997 the Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management was signed by Germany.

The Federal Government has made several attempts to reach a consensus with the opposition on energy policy and the use of nuclear energy. Following three attempts in the years 1993, 1995 and 1997 which met with no success, the Federal Government has taken action and put forward a bill to amend the Atomic Energy Act. By this means, reliable framework conditions for nuclear power plant development and for the federal strategy on radioactive waste management are set up. Among other points an amendment bill compromises a non-site-specific examination procedure for new nuclear power plants — e.g. the European Pressurized Water Reactor (EPR) — to be performed by the federal authorities, without affecting the competence of the Federal States under nuclear legislation. On 13 November 1997, the German Parliament, the Bundestag, approved the amendment to the Atomic Energy Act. The majority of Federal State Governments have rejected the Act. Further discussions are necessary, so the new Act is not yet in force.

An extended amendment of the Radiation Protection Ordinance to include the new European radiation standards 96/29/EURATOM is in preparation.

A guideline has been issued on "Requirements for Measuring Laboratories" to guarantee the necessary quality standards in the field of incorporation monitoring.

The Nuclear Safety Standards Commission (KTA) issued a new standard on "Pressure and Activity Retaining Components".

Since German unification, the Morseleben repository in the former German Democratic Republic has had the status of a federal repository for short-lived and low-level radioactive waste. From 13 January 1994 to 31 August 1997, a total waste volume of 14 869 m^3 and 372 spent sealed radiation sources were disposed of. The respective activity amounts to 5.1×10^{13} Bq. Plans to further expand this repository will not be pursued, because no need is seen to continue operating of Morsleben after June 2006.

The former iron mine Konrad is designated for final disposal of radwaste with negligible heat generation. The licensing procedure is in an advanced state. The licence is expected to be granted by the State of Lower Saxony at the end of 1997. The Federal Government has issued several directives to the State Environment Ministry of Lower Saxony to speed up the licensing procedure for a final repository at the Konrad site. After a construction phase of about four years the repository should go into operation in 2002.

The Gorleben salt dome is being investigated for its suitability for the disposal of all kinds of radwaste, particularly high-level waste and spent fuel. By mid-September 1997 drifts with a total length of 2600 m. had been excavated. The total length of exploratory drillings presently amounts to about 5800 m. After carrying out exploratory work for eleven years, on

10 November 1997 the Gorleben shaft 1 reached its final depth of 933 m. Operation of the repository is not expected to start before the year 2012.

At the Gorleben site there is also an interim storage facility for high-level radwaste as spent fuel or vitrified high-level radwaste from reprocessing abroad. Up to now, eight casks have been transported to the interim storage facility. On 5 March 1997, the third shipment arrived at the Gorleben site and was accompanied by violent anti-nuclear demonstrations.

On 7 March 1997, Advanced Nuclear Fuel GmbH (ANF) Lingen received a licence from the State of Lower Saxony to increase the capacity for the production of uranium fuel elements up to 650 t/y.

On 31 October 1997, the State of North Rhine–Westphalia granted a licence to Urenco Gronau to increase the capacity from 1000 to 1800 t separation work per year.

INDIA

India had actively participated in the negotiations of a draft convention on safety of radioactive waste management; while India considers that such a convention is a natural consequence to the convention on nuclear safety which was concluded in 1995, it has not been possible for India to agree to the concept of a joint convention on safety of spent fuel management along with safety of radioactive waste management.

Ultimate load capacity assessment of nuclear containment for postulated beyond the design basis accidents

Nuclear reactor containments, which are of prestressed and reinforced concrete construction, are the ultimate barriers against release of radioactivity. It is therefore important to demonstrate the ultimate load carrying capacity of the containment and provide assurance to public and regulatory bodies for ensuring the continued acceptability of nuclear power programme. The emphasis in Indian research and development programme has been to use experimentally benchmarked codes to predict the margin against various failure modes. This includes beyond design basis accidents, resulting in containment overpressurization, shock load as result of hydrogen detonation, aircraft impact and massive earthquake. Two finite element codes have been developed and benchmarked with analytical and experimental results of Mark III (BWR) containment, shell panels and a shear wall test for static and dynamic loads sponsored by the Nuclear Power Engineering Corporation (NUPEC), Japan. Using the predictions of these codes the factor of safety of the inner prestressed concrete containment and the outer reinforced concrete containment of a typical Indian PHWR has been assessed for various loads.

Assessment of TAPS core shroud

The twin nuclear reactors at Tarapur Atomic Power Station (TAPS), Tarapur, India, belong to the class of Boiling Water Reactors (BWR). Over the last few years, the core shroud of BWRs operating in foreign countries have been seen to have developed cracks at weld locations. The TAPS core shroud examination has not revealed the presence of any crack, so far. Nevertheless, detailed analysis was undertaken to assess its structural safety under postulated accident loads. As a first step detailed structural analysis was done for uncracked core shroud subjected to postulated recirculation line break (RLB), main steam line break (MSLB) and earthquake event loads. The RLB and MSLB event loads were evaluated by detailed thermal-hydraulic analysis. It was shown that there is sufficient margin against allowable stress values, plastic collapse and buckling. In the next step a through thickness crack was postulated at a weld location which experiences high stresses. The structural analysis was done for different crack sizes. It was shown that collapse will not occur even for large crack sizes.

Leak-before-break concept in design of piping

The traditional design basis event of a double ended guillotine break (DEGB) of primary heat transport system piping is being replaced by the concept of leak before break (LBB) for many reactor systems. The LBB approach aims at the application of fracture mechanics principles to demonstrate that pipes are unlikely to experience DEGB without prior indication of leakage. It shows that a through-wall leakage size crack is stable under the maximum credible loading condition. The analytical capabilities needed for demonstration of LBB are well developed and the concept has been applied to straight pipes, elbows and tees of the primary heat transport system of 500 MW(e) PHWR.

Some of the uncertainties related to material properties, however, need to be resolved. Towards this end, a comprehensive test programme has been launched involving fatigue and fracture tests on straight pipes and elbows. In the coming years, a large number of such tests would be performed to encompass the variation in parameters like diameter, wall thickness, crack lengths, etc. This will be accompanied by tests on specimens and the data generated will help in resolving issues like:

- Transferability of specimen J–R curve to components;
- Transferability of specimen fatigue crack growth rate to components; and
- Effect of cyclic dynamic loads on fracture resistance of crack components.

INDONESIA

On 10 April 1997 the Government of Indonesia passed Act No. 10 of 1997 regarding nuclear energy, to replace Act No. 31 of 1964 on Basic Stipulations of Atomic Energy. The main principles set out in Act No.10 of 1997 are, among others:

- Separation of the Regulatory Body from the Promotion Body:

  - Promotion Body will be responsible for undertaking only basic and non-commercial research;
  - The Regulatory Body will be responsible regulating and controlling all nuclear activities in Indonesia;
- Radioactive Waste Management will be arranged in a special Chapter, more comprehensive than Act 31 of 1964;
- Liability for nuclear damage will be arranged in detail, so that regulations on nuclear safety will be respected by all parties;
- Introduction of a Nuclear Energy Council which will be responsible for giving advice and judgement concerning the benefit and development of nuclear energy;
- Co-operation of the private sector in nuclear application activities for commercial purposes; and
- Criminal and financial penalties are more severe compared with Act No. 31 of 1964.

Implementation of some regulations from Act No. 10 of 1997 is in preparation, and as these regulations are determined, Act No. 31 of 1964 on the implementation of these regulations is still valid, as long as not in contradiction with the Act No. 10 of 1997.

IRELAND

Radon developments

In June, 1997, the Radiological Protection Institute of Ireland published the results of the second phase of its National Radon Survey covering the counties Carlow, Donegal, Kildare, Kilkenny, Laois, Leitrim, Longford, Meath, Offaly, Roscommon, Sligo, Waterford, Westmeath and Wexford. The survey is aimed at determining the geographical distribution of radon levels in dwellings in Ireland.

The mean annual indoor radon concentrations for the dwellings measured in the above counties ranged from 63 Bq/m^3 to 147 Bq/m^3 with individual values in excess of 1000 Bq/m^3. The Survey is based on the 10 km grid squares of the Irish National Grid system. Grid squares where the predicted percentage of dwellings with radon concentrations above 200 Bq/m^3 is 10% or greater are designated ‘High Radon Areas’.

In all High Radon Areas, the Institute would encourage householders to have radon measurements made in their homes in order to identify the individual dwellings with elevated indoor radon levels. Where high radon levels are found, householders are encouraged to take the necessary action to reduce the risks to themselves and their families.

The final phase of the Survey is currently under way in seven counties and is due for completion in 1998. A map entitled “Radon in Irish Dwellings” showing the results of the first and second phases of the Institute’s study has also been published. Data for further counties will be published as they become available.

In December 1997, Ireland's Minister for the Environment and Local Government published revised Technical Guidance Documents on Building Regulations. The regulations which will come into effect on 1 July 1998 will include the following radon combating requirements for new houses:-

New House in High Radon Area: Foundations must incorporate measures to protect the building from radon in the ground, e.g. a sealed membrane of low permeability and a potential means of extracting radon from the sub-structure - such as a pressure sump with outlet.

New House outside High Radon Area: Foundations must incorporate a potential means of extracting radon from the substructure.

MALAYSIA

Issues and developments

Malaysia has made initiatives towards improving its current legislation and has taken into consideration the adoption of the recommendations of ICRP 60 and the recommendations of IAEA's Safety Series No: 115. The National Sub-Standing Safety Committee that was established to review the existing Radiation Protection (Basic Safety Standards) Regulations 1988 (BSS) is now progressing and meeting regularly.

The National Policy on Radioactive Waste Management is being prepared and the first draft is expected to be completed by last quarter of 1998.

The Atomic Energy Licensing Board (AELB) has also developed an interactive homepage at the Internet site http://www.jaring.my/aelb, to enable users, especially licensees, to communicate electronically with AELB.

Significant achievements

The IAEA's safeguards inspectors who performed inspection on the TRIGA Mark II research reactor at the Malaysian Institute for Nuclear Technology Research (MINT) in 1997 were satisfied with the accounting and control of nuclear material at the facility.

In addition, an IAEA Integrated Safety Analysis of Research Reactor (INSARR) team that conducted an inspection on the same facility, gave it an above average performance on safety.

NORWAY

During 1997, a licence for construction of a combined storage facility and repository for low and intermediate level radioactive waste at Himdalen in Aurskog–Høland municipality has been given. The construction work will be completed in 1998.

PERU

In May 1997, radiation safety regulations establishing requirements for the protection of persons and the safety of radiation sources were approved by supreme decree. They are the result of the revision of regulations in the area of radiation protection in Peru that began in 1995. It should be mentioned that organizations and sectors involved in radiation protection, such as the Ministry of Health and the Ministry of Labour and Professional Associations, participated in the revision.

The publication of the ICRP 60 recommendations by the International Commission on Radiological Protection, together with the Agency's Basic Safety Standards in 1996, led to the identification of certain shortcomings in the national regulations which had to be resolved by revising and updating the main regulations.

In contrast to the previous regulations, the scope of the new provisions has been broadened to include the safety of radiation sources and other aspects that were not previously covered. Thus, the regulatory framework has been improved considerably. As is the case for any new norm, a one-year period has been foreseen for the existing safety levels of the facilities and activities to be brought in line with the new requirements, where appropriate. However, there are some provisions which have to be implemented before the end of the adoption period. This is the case with regard to activities in the areas of teletherapy and brachytherapy, where the time period has been specifically reduced.

In general, it may be observed that compliance with the new dose levels that have been established for occupational exposure has not proved difficult since the averages for the majority of practices are 4 mSv/year, with a few exceptions where the averages are approximately 8 mSv/year.

One of the problems anticipated is the implementation of the optimization process and the application of the dose constraints. It is hoped that these tasks will be given priority in the future, particularly where medical applications are concerned.

The enactment of the radiation safety regulations has made it necessary to revise other specific norms of a lower level. In particular, those that cover concepts such as "working conditions" or that are based on the previous limits have been revised. Modifications will have to be made to ensure that they are consistent with the main regulations, since they are being implemented according to different criteria.

PHILIPPINES

Emergency preparedness

The revision of the National Radiological Emergency and Preparedness Plan (RADPLAN) was completed and approved. The document implements provisions of Presidential Decree No. 1566 and the Calamities and Disaster preparedness Plan, specifically for radiation-related accidents and radioactive fallout. It covers all types of radiological emergencies involving the operation of nuclear and radiation facilities and the use and transport of radioactive material. RADPLAN emergencies also include external events involving spacecraft, nuclear ships, and nuclear power plants in other countries which may affect the Philippine population and environment.

The revised RADPLAN was prepared by the Philippine Nuclear Research Institute of the Department of Science and Technology and reviewed by representatives of 20 national agencies and approved by the National Disaster Co-ordinating Council Committee on Radiological Emergency. The RADPLAN is expected to contribute to the upgrading of the country's disaster preparedness, particularly in response to those caused by technological hazards.

The Philippines hosted the Regional Workshop on Emergency Planning, Accident Assessment and Response to Nuclear and Radiological Accidents which was attended by 24 participants (from 15 RCA[3] member countries). The workshop provided an opportunity for regional experts to be updated on the IAEA's latest guidance and manuals.

Regional co-operation

It is foreseen that the rising energy demand in the East Asia regional will see the increased utilization of nuclear energy as a source of power in the region. This development generates increasing concerns throughout the region over many important issues, most especially nuclear safety. In this regard, the Philippines has issued a call among countries in the region for the establishment of a focal point for promoting co-operation on nuclear power, and specifically in ensuring nuclear safety.

The Philippines hosted a five-member delegation from Viet Nam headed by the Director of the Viet Nam Radiation Protection and Nuclear Safety Authority which observed and discussed with local counterparts activities and practices on radiation protection in various fields of application in the Philippines from 1–6 September 1997.

International basic safety standards

The Philippines is committed to adopt the new International Basic Safety Standards (BSS). In this regard it is implementing an IAEA Technical Co-operation Project which is aimed at modifying national regulations to conform to the new BSS and developing national capability for emergency preparedness and response.

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[3] Regional Co-operative Agreement for Research, Development and Training related to Nuclear Science and Technology.

Infrastructure development

A new Harshaw 6600E Thermoluminescence Dosimetry (TLD) system has been commissioned. The system will allow PNRI to change from film to TLD for personnel monitoring of radiation exposures.

The centralized facility for low level radioactive waste management is being upgraded further. The Philippines has offered to be designated as IAEA regional demonstration centre for low level waste management in the RCA region.

The Philippines is an active participant in the RCA Project to Strengthen Radiation Protection Infrastructures (RAS/9/018) and strongly supports the continuation of the Project to Phase III.

RUSSIAN FEDERATION

Information on significant achievements in the area of nuclear safety in 1997 and information on the enactment or revision of laws related to radiation and nuclear safety

Following an instruction by the Government of the Russian Federation, the Ministry of the Russian Federation for Atomic Energy, together with the federal organs of the Executive, is developing a Common Federal Programme for Nuclear and Radiation Safety in Russia. The programme will be submitted to the Government of the Russian Federation in the first quarter of 1998.

This programme amalgamates all the existing Russian Federation programmes associated with nuclear and radiation safety that are being implemented or developed (18 programmes are combined). The main objective of the programme is to reduce the risk of any radiation impact on human health and the environment from nuclear and radiation facilities and from artificial and natural ionizing radiation sources to a socially acceptable level.

In order to take into account the recommendations of the IAEA's 1996 Regulations on the Safe Transport of Radioactive Material, the Ministry for Atomic Energy, together with the Federal Nuclear and Radiation Safety Authority of Russia and other federal organs of the Executive, is making preparations to issue national regulations on the safe transport of radioactive substances, which will apply throughout the Federation. The regulations are expected to be issued in 1998.

As a result of the implementation of the Federal Programme for Radioactive Waste Management, construction of liquid waste purification facilities in the North West (Murmansk) and in the Far East is being completed and their commissioning in the first quarter of 1998 will make it possible to eliminate the disposal of liquid waste into open bodies of water.

The Government of the Russian Federation has approved the Regulations for the Organization of the State System of Accounting for and Control of Radioactive Substances and Radioactive Waste.

The Ministry for Atomic Energy is moving over to the new radiation safety standards (NRB-96), which take international requirements into account. These standards are based on limitation of radiation detriment and radiation dose. The International Basic Safety Standards for Protection against Ionizing Radiation and for the Safety of Radiation Sources serve as a basis for the standards. The NRB-96 standards make a clear distinction between radiation protection of personnel and of the public during the use of ionizing radiation sources under normal conditions and in the event of a radiation accident. The transition to the new radiation safety standards is a complex, multifaceted process and constitutes the Ministry for Atomic Energy's main task in the field of radiation safety. The Programme's objective is to develop the necessary measures to bring about a radical regulatory restructuring of radiation protection methods and equipment, to organize training in the main provisions and requirements of NRB-96 and the Basic Health Regulations for Radiation Safety (OSPORB). The Department of Safety, Ecology and Emergency Situations has developed a subprogramme on the application of the NRB-96 Radiation Safety Standards at facilities of the Ministry of the Russian Federation for Atomic Energy.

Safety related laws and regulations

The Duma of the Russian Federation adopted the Federal Law of 10.02.97 N 28-fz "On Introducing Changes and Amendments into the Federal Law on the Use of Atomic Energy" which clarifies issues related to ownership for radioactive substances.

For the purpose of setting out the legal basis on the state safety regulation system in nuclear energy use, Gosatomnadzor of Russia prepared Decree of the President of the Russian Federation "On the Federal Executive Bodies Authoized to Carry Out State Safety Regulations in Nuclear Energy Use" dated 21 October 1997 N 26. That Decree determined also such executive bodies and the procedure of their interaction.

In order to develop a licensing system related to nuclear activities and meet the requirements of the Federal Law "On the Use of Atomic Energy", Gosatomnadzor of Russia prepared provisions on the licensing procedure for nuclear activity approved by Decree of the Russian Government dated 14 June 1997 N 865. Provisions include a list of nuclear activities licenses for which are issued by Gosatomnadzor of Russia and determine a procedure for issuing, suspension and cancellation of such licenses.

For the purpose of implementation of the Federal law "On the Use of Atomic Energy" the Russian Government approved the following legal acts developed by Ministries and authorities of the Russian Federation:

- Decree of the Russian Government dated 28 January 1997 N 93 "On the Procedure for the Development of Radiation Hygienic Passports of Organizations and Territories";

- Decree of the Russian Government dated 3 March 1997 N240 "On the Approval of the List of Positions for Staff of Nuclear Facilities which are to be Granted with a Permit of Gosatomnadzor of Russian for Carrying out Nuclear Activities";
- Decree of the Russian Government dated 7 March 1997 N306 "On the procedure of Making Decision related to Siting and Construction of Nuclear Installations, Radiation Sources and Storage";
- Decree of the Russian Government dated 5 April 1997 N392 "On the Approval of the Provisions on the Ministry of Atomic Energy of the Russian Federation";
- Decree of the Russian Government dated 7 May 1997 N557 "On the Approval of the List of the most Nuclear Hazardous Installations";
- Decree of the Russian Government dated 18 August 1997 N1009 "On the Approval of Procedures for Development of Legal Acts of the Federal Executive Authorities and their State Registration"; and
- Decree of the Russian Government dated 15 August 1997 N1039 "On the Procedure of the Notification of the Executive Authorities during Launching of a Space Apparatus with a Nuclear Energy Source as well as the Notification of the Local Authorities and Rendering Assistance, if necessary, to the Population in Case of an Emergency Return of such Apparatus to the Earth".

The following normative documents were developed by Gosatomadzor of Russia and enacted in the area of nuclear and radiation safety regulation:

- "Provisions on the Procedure of Investigation and Reporting of NPP Incidents", PNAE G-12-005-97 (Decree of the Russian Government dated 19 December 1997 N12); and
- "General Provisions on NPP Safety" PPB Safety. OPB-88/97 `PNAE G-01-011-97 (Decree of the Russian Government dated 14 December 1997 N9).

SLOVAKIA

Nuclear, radiation and waste safety

There are in Slovakia four nuclear power units in operation with 440 MW(e) capacity each, a shutdown HWGCR (Bohunice A-1 NPP) in the decommissioning stage, an interim spent fuel storage facility with storage capacity of 600 t U, and radwaste treatment facilities based on cementation, bitumenization, vitrification, incineration technologies. There are also four nuclear power units in construction with 440 MW(e) capacity each and a low and medium-level radwaste repository situated at Mochovce, which are supervised by Nuclear Regulatory Authority of the Slovak Republic (ÚJD SR). The Ministry of Health supervises radiation safety.

Operation of the four nuclear power units (WWER-440) in Bohunice, which are still the most important components of the Slovak power sector, remained stable and reliable. Safety indicators were satisfactory; e.g. fault rates, and low collective radiation dose and radioactivity effluents. Only one event has been classified as class INES I in 1997.

The Law on Peaceful Uses of Nuclear Energy (Atomic Act) has been reviewed and endorsed by the Slovak Government and in November 1997 it was submitted to the Parliament. The draft of new regulations on Transport of Nuclear Material and Radwaste, Emergency Planing and Quality Assurance has been also prepared.

The second stage of the Safety Upgrading Programme on Bohunice V-1 NPP (WWER 440/230 units 1 and 2) began in 1996. The most important safety measures implemented in 1997 by the consortium REKON (consisting of VÚJE Trnava and Siemens AG) are: new pressurizer safety and relief valves, an additional new independent emergency steam generator feedwater system with 2 × 100% redundancy, installation of new steam dump valves on each steam generator steam line, emergency AC power supply from the Madunice hydropower plant, and preparatory works for implementation of the entirely new reactor protection system (based on digital technology). The Safety enhancement programme for Bohunice NPP units 1 and 2 will continue in 1998 and 1999.

A comprehensive review of safety was carried out at the Bohunice units 3 and 4 in 1995. The safety review included an assessment of revised Safety Analysis Report developed after 10 years of the plant operation. Based on the review and assessment the ÚJD SR has requested a short-term safety improvement programme to be implemented by the year 1999. Currently about one third of the required measures have been implemented.

During the completion of the first two units of Mochovce NPP (WWER-440/213), 87 safety upgrading measures have been developed, and contracts with EUCOM (Siemens and Framatome), Škoda, EGP Prague and suppliers from the Russian Federation have been signed for their implementation. The safety upgrading measures are categorized, according to their safety issues ranking, into 3 categories set-up by the IAEA. The most important of them are required to be implemented before the first fuel loading. The unit 1 cold hydro test programme has been started at the end of 1997 and fuel loading is scheduled for the middle of 1998.

Decommissioning activities at A-1 NPP in 1997 were concentrated on testing and commissioning of equipment for draining and re-packing of damaged spent fuel assemblies from the near reactor storage pond. Based on a reviewed intergovernmental agreement, two transports of spent fuel were forwarded to the Russian Federation in 1997. Transport of this spent fuel type will continue in 1998 and 1999.

The interim spent fuel storage facility for WWER-440 spent fuel operated at the Bohunice site is based on wet cooling technology. About 20% of spent fuel stored was originally irradiated in the Czech Republic. This was transported back to Dukovany NPP and transport was finished in 1997. Essential extension of the storage capacity will be reached by modification based on better utilization of the pool volume (using also borate steel in the basket material). Seismic reinforcement of systems and structures of the storage will be also implemented in the course of the reconstruction, along with storage capacity extension. Regulatory approval was issued in October 1997 and implementation is scheduled to continue until the year 2000.

A near surface disposal facility for low and intermediate level radwaste is built at Mochovce site with a capacity of 36 000 m^3. In 1997 a new drainage system was constructed as one of modifications required by the ÚJD SR during the licensing process. The facility for production of special high integrity concrete containers (FRC) under licence from SOGEFIBRE (France) was commissioned in 1997.

The ÚJD SR participated in many of the international nuclear regulatory meetings and is actively developing its international contacts. To date it has signed agreements with five other regulatory bodies: US NRC, DSIN (France) and HSK (Switzerland), SÚJB (Czech Republic) and Gosatomnadzor (Russian Federation). To date governmental agreements are concluded with the Czech Republic, Austria, Russian Federation, Hungary, Poland, USA and Canada. ÚJD SR is also a very active participant in the Agency's Extrabudgetary Programme on WWER safety. ÚJD SR is now consider the foremost body in Slovakia on international nuclear matters.

Under the bilateral agreements further co-operation and exchange of information in the field of nuclear safety and emergency preparedness have started.

ÚJD SR has continued to express considerable satisfaction with the assistance given under the Agency's technical co-operation programme. The Model Project of technical assistance focusing on strengthening the capabilities of ÚJD SR was successfully concluded in 1997. The speed and the flexibility with which the Agency responded to ÚJD SR's original request for the assistance was crucial in the development of ÚJD SR's capabilities. The project, which included 42 expert missions and substantial training activities, has had an important impact on the progress of the ÚJD SR and its profile within both national and international areas.

SLOVENIA

Modernization of the Krško NPP

The Krško NPP, in commercial operation since 1983, is a 632 MW Westinghouse PWR and it is licensed for 40 commercial power years (up to 2023). In 1997 the Krško NPP generated 4.79 TWh of electrical energy. The generator was connected to the electrical grid for 7840 hours or 89.5% of the total numbers of hours of the year. The electrical production was 7% higher than planned.

Due to the previous problems with steam generators (SG) the plugging is approaching to the licensed limit of 18% and the utility decided to plan and perform a package of plant modernizations. A major part in this package will be steam generator replacement, along with a power uprate.

At the end of 1996 the manufacturer of new steam generators was chosen: a consortium of Framatome and Siemens. The utility and the Slovenian Nuclear Safety Administration (SNSA) have already been present at manufacturing of some important SG parts through QA audits. In parallel with the SG manufacturing, the process of safety aspects evaluation concerning steam generator replacement and power uprate started. The policy of close co-operation between nuclear safety authority and utility was chosen, which leads, step by step, to a licensing process. Technical Support Organizations are contracted for overview and independent expert opinion for all safety evaluations.

The Krško NPP has no full scale plant specific simulator. All operators are trained on the simulators in USA. SNSA decided that a full scale simulator should be installed in Slovenia by the year 1999. In 1997 the bidding process was concluded and preparation work started. Modification packages will require a large amount of manpower resources. The Slovenian utility plans that this package will be done by the end of this century.

PSA analysis in Slovenia

PSA level 1, level 2 and Shutdown PSA for the Krško NPP were completed at the request of SNSA. The review, performed by the IPERS mission (level 1 and level 2) and an independent technical support organization (Shutdown PSA) found that the PSA study is in general a fair representation of risk level of the Krško NPP. The results of the study show that core damage frequency is comparable to other plants of similar type. Level 1 results (internal events) show a core damage frequency of 5.4×10^{-5}.

The major characteristics of risk insights from the Krško NPP PSA are:

- a relatively high level of fire risk (10^{-4}); and
- loss of off-site power, and the NPP's ability to respond to such events, is a dominant risk factor.

Some measures to decrease the fire risk have already been taken (i.e. a fire protection action plan) and some of them are under preparation.

Radiation monitoring system in Slovenia

An early warning radiation monitoring system in Slovenia started in 1991 with a network of twelve independent gamma monitors, located at meteorological stations. Up to 1997 the whole system has been upgraded to 40 gamma dose-rate meters, which are distributed over the territory of Slovenia and especially around nuclear installations. The prompt results are displayed on the World Wide Web (for example, http://www.sigov.si/cgi-bin/spl/ursjv/intranet/functiona.html). At the very end of 1997 the first set of results were transferred to the international data exchange center EURDEP at the JRC in Ispra (Italy).

With a provisional project on the Slovenian early warning system elaborated in 1997, the new trend was introduced in further development of the network. In the frame of the IAEA Technical Co-operation Programme SLO/91005 Slovenia got approved more specifically oriented equipment, such as a portable gamma spectrometry system for deposition measurements, and an automatic aerosol monitoring device for gamma emitters and iodine in the air, together with the alpha/beta artificial activity option. The first aerosol system will be installed in the first half of 1998.

SPAIN

Facilities monitoring and control

Nuclear Plants

In 1997 all seven nuclear power plants in Spain were in operation, with their nine reactors, under the safety provisions established by the CSN and monitored by the resident inspector permanently assigned to those facilities. José Cabrera, Santa Maria de Garoña, Cofrentes, Trillo, Vandellós II, Almaraz I, Almaraz II and Ascó I had refuelling shutdowns and, as a whole, all plants experienced 14 automatic non-programmed shutdowns.

CSN specialists carried out 189 inspections throughout the year and made a remarkable assessment effort concerning repairs and replacements of main parts that some plants performed in 1997.

In particular, in the first semester of 1997 the programme to replace steam generators in Almaraz and Ascó was completed with the change of the equipment belonging to unit II in Almaraz. In this unit, as in unit I, the vessel head and the turbine were replaced — the entrance and exit of all the equipment made it necessary to make an opening in the containment building. This hole was afterwards repaired to its original state and the condition of the building was assessed through some tests similar to those performed when the plant was first started.

During the refuelling shutdown in the José Cabrera plant, the head of the reactor's vessel was replaced — it had been affected by some cracks in the penetrations of control rods and had been repaired in 1995 to allow for safe operation during the previous cycle. A new system of nuclear instrumentation was also implemented to replace the old one, as well as a visualization system for safety parameters.

During the shutdown in Santa Maria de Garoña in March, the internal barrel was repaired. The CSN, in a monitoring operation carried out the previous year, had called for a complete repair of the component due to a cracking problem.

Vandellós and Cofrentes, after due authorizations by the CSN, had some work done to enlarge the capacity of the irradiated fuel storage tanks. Cofrentes was also authorized, as operative cycle number 11 began in the plant, to increase its power to 104.2%.

After more than two years of work, 1997 saw the completion of the programme for Analysis of Operating Experience and Systems (AEOS) in the nuclear plant at Trillo, which had been started in January 1995, in order to detect and correct possible design deficiencies in the plant.

In the systematic and continuing monitoring of plant operation, the CSN makes sure that the established limits and conditions are satisfied by licensees. In 1997 the CSN proposed the opening of sanction procedures in five cases. In José Cabrera's case it was the nonconformance of its official operation register with regard to a periodical monitoring of the parameters in the core. Ascó did not comply with the operational specifications concerning the minimum flow of the residual heat removal system during the shutdown of unit I. In the nuclear plant at Almaraz, CSN proposed a sanction for failing to comply with the operating procedures concerning the registry of inoperabilities of safety equipments. As for Vandellós II, the plant failed to comply with the Technical Specifications and the Guide for Quality Assurance in issues concerning instrumentation, seismic and environmental qualification. Finally, sanctions were proposed against Santa Maria de Garoña due to non-compliance with specifications concerning the requirement to monitor safety valves of the reactor coolant system.

In 1997 there were 72 INES level 0 events in Spain, i.e. events without any safety significance, and two level 1 events, which took place in Almaraz II and Garoña. The former was a delay in the insertion of 3 of the 48 control rods and the latter the inadequate application of a requirement to monitor safety valves in the reactor coolant system.

Fuel cycle facilities

In 1997 the CSN made 17 inspections of the operating fuel cycle facilities, which showed the normal development of their activities.

A significant incident took place in February, when the nuclear fuel factor at Juzbado mistakenly sent to the USA six supposedly empty containers, which actually contained 102 kg of uranium oxide. The CSN carried out an event investigation and concluded that it might be considered as a negligence. Therefore it proposed the opening of sanction procedure to the Ministry of Industry. It also reported its conclusions to Congress and to the Court of Justice of Salamanca, at their request. The event was designated as level 1 on the INES scale.

Moreover, during visual inspection at the reception of fresh fuel in the nuclear plant at Cofrentes, a defect was detected in some rods. The CSN concluded in its investigation that these defects did not affect nuclear safety, but indicated failure in the physical protection of the plant and therefore required additional measures besides the already existing ones.

"Radioactive facilities"

By the end of 1997 there were in Spain 15 601 "radioactive facilities", 1286 of which had scientific, medical or industrial uses and were directly assessed and reported on by the CSN. The other 14 315 were X ray facilities for medical or veterinary diagnosis, included in the registries of the Autonomous Regions, and mostly under the indirect control of the CSN through certified organizations that inspect and monitor them or, exceptionally, under its direct supervision.

Throughout the year, CSN specialists or, in some cases, those services in the Autonomous Regions that have been commissioned by the CSN, carried out a total of 1601 inspections, mainly in order to monitor operations. The CSN issued 384 reports authorizing the construction, starting, modification or closure of this kind of facility.

The CSN suggested to the Ministry of Industry and Energy (or, in cases within their competencies, the appropriate Autonomous Region), the opening of 24 sanctions files concerning several non-conformities or irregularities.

Every worker who operates or supervises a facility of this type needs a license issued by the CSN, which must be renewed after a period of time. By the end of 1997, approximately 45 000 people were licensed to work in radiodiagnosis facilities (21 870 to manage facilities and 24 959 to operate them). Furthermore, over 5500 workers were licensed to work in other radioactive facilities, 3639 of whom were operators and 1891 supervisors.

The CSN encourages a safe environment in radioactive facilities in order to improve safety and protection conditions. Throughout the year a special effort was made to optimize dose control in industrial and medical facilities.

Transportation

The authorizations needed to transport certain radioactive materials can be granted only after a favourable report by the CSN. The CSN is also in charge of verifying whether packaging and vehicles comply with both national and international regulations concerning the conditions for safe transportation. Throughout the year CSN inspectors supervised 119 waste, source and fuel transports.

Radioactive waste control

The CSN's goal in monitoring activities related to radioactive waste is to ensure that it is managed under the necessary safety conditions. To that end the recommendations of international organizations are adopted, establishing a comparable level of protection for workers, the public and the environment at an international scale.

In 1997 the CSN extended its waste management control in nuclear and radioactive facilities, through all their stages, and started new actions particularly oriented towards improving safety in the long term. Foremost among them is the development of a methodology to declassify materials with low concentrations of radionuclides, with the ultimate goal of limiting the application of strict safety measures to the management of waste whose potential risk requires it.

Low and medium level waste production in nuclear and radioactive facilities suffered no remarkable incidents in 1997 and was under CSN control. Several audits were performed concerning the interface between every nuclear plant, as a waste producer, and Enresa, being the final manager, in order to verify that the established criteria were respected.

Finally, the CSN monitored the withdrawal of the 1403 radioactive lightning rods dismantled throughout the year which, together with those dismantled in previous years, add up to a total of 18 048. The heads were sent to the United Kingdom.

High level waste and spent fuel management was controlled in 1997 through activities that followed two lines, concerning temporary management and long-term management.

The former, whose goal is an increased control of high level waste temporary management, mainly in the case of spent fuel stored in nuclear plant's tanks, comes down to controlling the inventory and enlargement of the tanks' capacity. In 1997 some new racks were put in place for the pools in the plants at Vandellós II and Cofrentes, and the CSN examined plans to increase the capacity of the pools at José Cabrera and Santa Maria de Garoña plants. In addition, a favourable report was issued concerning the design of the dual-purpose container ENSA-DPT for transport and storage of spent fuel in the nuclear plant at Trillo.

With regard to long-term management control, which intends to establish guidelines for the appropriate regulatory framework, international developments were continuously followed, as well as the state of waste management in countries with advanced policies and programmes, such as the USA, Sweden, France, Finland, Switzerland and Germany.

Dismantling and closure of facilities

In 1997 the CSN kept monitoring the implementation of the Dismantling and Closure Plan of the experimental plant for the treatment of uranium Lobo-G, which ended in July. After an assessment of its final condition and the CSN's approval, a programme for radiation monitoring and specific control began so as to verify that the established safety goals will be fulfilled.

In addition, the CSN closely watched Hifrensa's activities to decontaminate the spent fuel tank and the emptying of the graphite deposits at Vandellós I. Moreover, the CSN completed its assessment of the Plan for Dismantling presented by Enresa and issued a mandatory report to the Ministry for the Environment, concerning the environmental impact of dismantling works, so that it could be taken into account in the Statement on Environmental Impact.

The CSN also issued a favourable report on the Dismantling Plan of the research reactor Argos at Universidad Politécnica de Cataluña and kept supervising the programme for monitoring and control of the uranium plant at Andújar.

Public and environment protection

The operation of nuclear plants and the use of radioactive products in other facilities must be closely monitored so that its impact on the workers who handle such material, the surrounding population and the environment be the minimum possible. The CSN carries out this monitoring work in different ways.

On the one hand, the focus is logically on the land surrounding the facilities, where the operators perform radiation controls by means of plans approved by the CSN and verified through independent surveys. In 1997 the results of such plans were assessed, with over 12 000 samples collected and 75 000 determinations taken for the whole number of nuclear plants and cycle facilities. The results showed values without any radiological significance.

Additionally, the CSN controls and monitors environmental radiation quality by means of a national network that measures radioactivity rates in the air through 23 automatic stations. In 1997 the data provided by this network of environmental radiation monitoring (Revira) indicated values consistent with the radiation expected in each area, thus not revealing any abnormal situation. Throughout the year, the CSN monitored survey stations established in co-operation with 14 laboratories from nine Autonomous Regions, and verified that the values obtained were far below the limits.

Furthermore, in 1997 measurements obtained at the survey points along Spanish rivers and coasts during the 1996 campaign were analysed and it was possible to verify the lack of significant radioactive isotopes in the water.

Workers protection

One of CSN's main goals is to ensure the radiation safety of those workers who, for occupational reasons, are exposed to ionizing radiation. All of them, whatever the kind of facility they work in (industrial, medical or scientific), undergo dosimetric control and specific medical monitoring.

In order to monitor the dose received by these workers the CSN has a National Dosimetric Bank (BDN) which contains dosimetric data concerning 158 901 workers, 17 666 facilities and 14 632 companies.

In 1997 a total of 86 223 workers were monitored by dosimeters. As a whole, they received a collective dose of 53.26 man·Sv, the average individual dose per year being 0.8 mSv. From the total number of workers, 99.91 per cent received doses lower than 20 mSv.

In addition to external dosimetry, in nuclear plant activities, 15 140 controls were performed to rule out the presence of internal pollution. Only in one instance was significant contamination detected, related to an incident during the dismantling works at Vandellós I, which produced effective dose values of 31 mSv and 576 mSv organ dose, both numbers lower than the established limits.

Although the applicable effective dose limit per year is 50 mSv, the doses received by workers were far from that value and only 71 workers showed doses higher than 20 mSv, which reveals that Spain is in good condition to comply with the dose limits established in Euratom's Directive 96/29, which will be in force in the year 2000.

International activities

The CSN has multiple connections with organizations of similar responsibilities in other countries, which allows for a continuing and fruitful exchange of knowledge and expertise concerning nuclear safety and radiation protection.

The institutional relationships that link the CSN to fifteen other countries are updated through the renewal of protocols, agreements and conventions signed with organizations of similar responsibilities. In 1997, the CSN signed or renewed agreements with China's Nuclear Regulation Administration, the Republic of Ukraine's Ministry of the Environment and Nuclear Safety and Sweden's Radiation Protection Institute.

The CSN has contributed to the progress of two important international conventions. One of them, the Convention on Nuclear Safety, entered into force in 1996 and in 1997 approved the rules and procedures for its implementation. The CSN, which took part in the preliminary meeting of the parties that was held in April, assumed the responsibility of preparing the National Report before September 1998. Moreover, the International Convention on the Safe Management of Spent Fuel and Radioactive Waste, whose elaboration involved the CSN within the experts team, was approved in September 1997 and delivered for signature to member countries.

At the request of the IAEA, Spain was invited to host an International Conference about the health effects of low radiation doses and the related regulatory issues. The conference was organized jointly with the World Health Organization (WHO) and with the assistance from United Nations Scientific Committee on the Effects of Atomic Radiation, UNSCEAR. The conference, held in Seville in November 1997 and hosted by the CSN together with other Spanish institutions, raised great interest within the international community, as showed by the participation of over 500 experts from 65 countries, as well as five international organizations.

The CSN contributes to the technical assistance programme of the IAEA, both as a financial contributor and in experts' training. In 1997 the CSN welcomed several specialists from Mexico, Cuba, Armenia and Belarus, during different length stays.

Within the European Union, the CSN takes part in the activities of the working groups created in connection with the provisions of the Euratom Treaty referred to public and environmental protection against ionizing radiation. It also belongs to the bodies created within the European Commission to assist, in nuclear regulatory matters, those countries that have nuclear reactors of Soviet design, through RAMG (Regulatory Assistance Management Group) and CONCERT. This last group, which consists of nuclear safety agencies from EU and non-EU countries, is chaired, since December 1997, by CSN's vice-chairman. Within the RAMG programme, several CSN specialists met during 1997 with the agencies in charge of nuclear safety in Ukraine and Slovenia. Moreover, some CSN experts took part in several seminars held in Slovenia to discuss changes in plant design, legislation and regulations.

The CSN keeps an active relationship with the Nuclear Energy Agency of the OECD. Besides working in the standing committees, the CSN hosted in Cordoba, together with Enresa, an important conference with representatives from 15 countries and 71 experts, as well as representatives from international organizations, in order to discuss regulatory issues in long-term safety of radioactive waste.

Spain, through the CSN, is a member of the International Nuclear Regulators Association (INRA), that includes eight countries with a very large experience in regulatory activities, and was established in May 1997. Among the specific issues the INRA will deal with are the regulatory implications of the electricity industry's restructuring in several countries and the assistance to regulatory organizations in Central and Eastern Europe.

The CSN has promoted the Forum of Ibero-American Regulatory Agencies, with representatives from Argentina, Mexico, Brazil and Cuba, that is, those countries with nuclear installations. During its first meeting held in Veracruz (Mexico) in July 1997, the guidelines were established in order to encourage the exchange of technical, legal and organizational information. The Forum's activities will complement existing international programmes concerning nuclear safety and radiation protection.

SWEDEN

The nuclear power option in Sweden

On March 14, the government issued its bill on the energy policy to the Swedish Parliament. The objective of the new energy policy is stated to be to "create the necessary conditions for an efficient use of energy and cost effective supply of energy with a low impact on health, environment and climate, and also facilitate the transformation into an ecologically sustainable society".

The proposal includes the closure of the boiling water reactor Barsebäck 1 by 1 July 1998 and, provided that sufficient energy saving and/or replacement supply is at hand, closure of Barsebäck 2 (BWR) by 1 July 2001. The closing of the first reactor shall mainly be compensated for by reduced use of electricity for heating. Future decisions on phasing out the other ten reactors should take into account safety and technical lifetime aspects, as well as effects of energy conservation measures and availability of alternative energy sources. No time limit is, however, set for operation of the reactors at the other nuclear power sites.

To be able to enforce the nuclear energy policy as described above, the government has proposed a special law on the phasing out of nuclear power. The law was adopted by Parliament on 18 December 1997 and enters into force on 1 January, 1998. The proposed law empowers the government to revoke the operating licenses of the Swedish nuclear power reactors, not, as now, only for safety reasons, but also in order to "facilitate the transfomation into an ecologically sustainable society". Siting and the age and technical status of the plants are among the factors to be taken into account when deciding the order in which the reactors shall stop operation. When the government revokes the operating licence, the owner of the reactor shall be compensated for economically.

The new energy policy is backed by the social democratic, the left and the centre parties, together representing a majority in the Parliament.

Currently operating reactors and the licensing situation

There are 12 licensed power reactors in Sweden, the Forsmark and Oskarshamn sites each with three BWRS, the Barsebäck site with two BWRs and the Ringhals site with one BWR and three PWRS. All are currently operating. Additionally, there are other types of nuclear facilities in operation, such as a fuel fabrication plant, a research reactor and various nuclear waste facilities.

The operating licences granted for nuclear power reactors commissioned after 1980 are valid until the expiry in the year 2010. The four oldest reactors have no time limits assigned to them (Barsebäck unit 1, Oskarshamn units 1 and 2, Ringhals unit 1).

Operating experience and events of safety significance

During 1997 a number of events have been recorded and some rated on the international nuclear event scale, INES. These events have been reported separately.

Requirements on nuclear and waste safety

The SKI was given the authority to issue legally binding general regulations as from 1993. In 1994 the first regulations according to this new authorization came when the SKI issued its regulations on mechanical devices in nuclear installations. The SKI has now continued its work on general regulations and has issued draft regulations on "Safety in Nuclear Facilities". These regulations concern all the nuclear facilities in Sweden and are broad in scope in that they concern reactor safety, waste management as well as physical protection and on-site emergency management. They contain basic design and operational requirements to be fulfilled by the licensees at their facilities. They also contain requirements on the quality systems of the licence holders as well as on their system for internal safety review and assessment. Finally, they include requirements for reporting to the SKI. It is planned that they will enter into force as from 1 January 1999 following an extensive and broad peer review process.

Moreover, the SKI has drafted a document defining the basis for future regulations on the safety of final disposal of spent fuel and nuclear waste. The document gives premises for safety assessment, e,g. safety assessment methodology and time frames. The document has been sent out for national as well as international review and comment. The draft and the comments received will be used in the development of regulations that are planned to come into force at the beginning of 1999. Also other regulations are being planned for the waste management area.

Finally, the SKI has indicated to the utilities that an increased level of safety will be required for prolonged operation of the Swedish nuclear power plants. The SKI is presently preparing for these new safety requirements and discussions have started with the utilities on the process along which these requirements are to be implemented. In particular, the SKI has given some advance indications on this matter to the OKG utility that is modernizing the Oskarshamn 1 unit. Initiatives are also being taken by the Swedish nuclear industry to define the goals for nuclear safety in the future. As a step in this process Swedish utilities participate in the development of the European Utility Requirements (EURD) project and the SKI takes part in the regulators' review process of these requirements.

Nuclear waste and spent fuel

The Swedish Nuclear Fuel and Waste Management Company (SKB) continues its Programme on Research, Development and Demonstration (RD&D). This includes technological development of a repository system (deep geological disposal) and a process to find a site for the repository. SKB is encountering difficulties in the siting process and in September 1997 a local referendum in one of the municipalities where feasibility studies were going on resulted in a recommendation not to go on with further activities in that municipality (Malå).

SKB has applied for a licence to increase the capacity of the existing facility for central storage of spent fuel (CLAB) at the Oskarshamn Nuclear Power Plant from 5000 tons to 8000 tons. This expansion is necessary as the existing capacity will not cover the needs after 2004. SKI is presently reviewing the application. CLAB is also undergoing an As Operated Safety Assessment Review by SKI after an operational period of more than ten years. This is the first review of that kind for a nuclear facility in Sweden not being a nuclear power reactor.

Favourable response from Government to SKI strategic plan

In 1994 the Swedish government decided that an international review group, the Commission of enquiry for an international review of Swedish nuclear regulatory activtties, should be appointed to review and assess the quality of the Swedish regulatory supervision of reactor safety and of the handling, storage and final disposal of nuclear waste. The Report was submitted to the Minister of the Environment on 10 May 1996. In general terms, the opinion of the Commission was that the regulatory work of the SKI and the SSI (the Swedish Radiation Protection Institute) adequately serves its purpose, and the Commission concluded that "The SKI and SSI are providing ample assurance of the confirmation and further development of safety and radiation protection in Swedish nuclear power production and waste management through their regulatory activities". They also concluded that "Swedish regulatory activities are conducted in a satisfactory manner, compared with the practice in other countries with a similar approach to safety as that of Sweden".

The Commission also identified areas in which the SKI and SSI should consider changes of the manner in which the activities are carried out in order to increase their effectiveness within available resources. Such areas concern the promulgation of general regulations, the elaboration of more measurable objectives and the implementation of a modem internal quality systems.

The SKI welcomed the report and has seen it as a vehicle to further enhance the quality and efficiency of the work of the organization. In its response to the report, the SKI proposed to the government a strategic plan comprising proposals for more elaborate objectives as well as a revised regulatory strategy. As concerns the regulatory strategy, the SKI emphasized the importance of issuing regulations, the further development of the process oriented inspection methodology and the continuation of the development of methods to carry out integrated safety assessments. Moreover, the SKI indicated that it had reviewed its human resource strategies in order to broaden the competence and skills of its staff to take on more responsibilities of managerial and technical nature. The SKI also informed the government about the progress made since the launching of its new quality system, which is centred around the words Safety–Competence–Integrity.

SKI has had a favourable response from the government on its report. In fact the government has recently accepted the proposals by the SKI. As a consequence of this, the SKI has got additional resources for its regulatory and research work, particular for the purpose of the supervision of the phasing out of nuclear power and for technical support in the area of nuclear safety and waste management.

THE FORMER YUGOSLAV REPUBLIC OF MACEDONIA

Information on laws and regulations in the field of radiation protection and waste safety

1. *Law on protection from ionizing radiation and on nuclear safety, 1997/98.* A working version has been prepared and will be submitted to the concerned institutions for reviewing and considering opinions, remarks and suggestions that will be taken into consideration. Afterwards this will go into procedure as a draft law.

2. *Establishment of a Regulatory Body for Radiation Protection, proposal by the International Agency for Atomic Energy (IAEA):* Our proposal is to reinforce the role of the Republic Sanitary and Health Inspectorate and the Department for Radiation Protection at the Republic Institute for Health Protection, Skopje (deadline: 1998); the precise arrangements will be specified by law.

3. *Establishment of register for sources of ionizing radiation in the Republic of Macedonia:* The Register has already been prepared and certain corrections and supplements are being made by the Republic Sanitary and Health Inspectorate. The Registry is located in the Department for Radiological Protection at the Republic Institute for Health Protection, Skopje.

4. *Supply of equipment for the Register*
    - A computer has been received with software for keeping the Register from the IAEA, and is located in the Republic Institute for Health Protection, Skopje;
    - An alpha–beta monitor has been received, for detection of alpha–beta sources of ionizing radiation, and is located in the Republic Institute for Health Protection, Skopje;
    - A calibrator has been received for calibration of instruments, and is located in the Republic Institute for Health Protection, Skopje;
    - Supply of equipment concerning internal contamination of persons professionally exposed to ionizing radiation is expected in 1997/98.

5. *Supply of dosimeters for extremity doses* (deadline 1997/98).

6. *National personal monitoring system has been established.*

7. *Introduction of radiation protection in medical practice* (deadline 1997/98): Activities are under way.

8. *Designating a location and construction of dumping ground for radiation waste* (deadline: 1997/98): Activities have been performed by the Republic Sanitary and Health Inspectorate concerning the location of the dumping ground for radiation waste and working out a project for the dumping ground.

9. *Preparation of a plan and establishment of responsibility in case of risk of a nuclear accident* (deadline: 1997/98): The responsibilities will be regulated by the Law on protection of ionizing radiation and on nuclear safety, and by the regulations; however, the deadline will be extended.

10. *Study visits have been made by responsible officers to international seminars organized by the IAEA in*:
    - Bratislava — concerning detection of sources of ionizing radiation and keeping the Register;
    - Dubrovnik — concerning preparation of the law on protection from ionizing radiation and on nuclear safety, and concerning the by-laws; and
    - Zagreb — concerning safety and working with radiation sources and their dumping.

11. *Assistance has been given by the IAEA experts in the Republic of Macedonia (on the spot), concerning:*
    - Selecting a location of the dumping ground for the radioactive waste;
    - Assistance concerning the preparation of the law on protection from ionizing radiation and on nuclear safety; and
    - Assistance concerning the keeping of the Register of sources of ionizing radiation.

TUNISIA

The development of socio-economic activities during recent years has led to appreciable growth in the number of devices using sources of ionizing radiation. To maintain this development it is necessary to have a framework of nuclear, radiological and radioactive-waste safety.

As Tunisia has no reactor and does not produce high voltage generators, it has to import all sources of ionizing radiation. Their import and use require prior authorization by the National Radiation Protection Centre (CNRP).

1. The **nuclear and radiological safety** measures taken by the CNRP cover:

    - The establishment of an inventory of ionizing radiation sources indicating their users, areas of utilization, geographical distribution and characteristics. This inventory is based on the licensing records and is updated regularly;

    - The supervision of active radiation sources, involving the inspection of:

- Facilities using ionizing radiation sources in both the medical field (radiodiagnostics, nuclear medicine and radiotherapy) and the non-medical field (industry, agriculture and research);
- Places where radioactive sources are stored;
- Collective monitoring equipment;
- Individual dosimetry systems.

- The implementation of a programme for the transport of radioactive sources involving:
    - Co-operation of the CNRP with the Legal Unit of the Ministry of Transport in the drafting of law No. 37-97 on the land transport of dangerous goods including radioactive substances;
    - The establishment of rules of good conduct pending the entry into force of the above law and of the regulations which are in preparation: packaged and labelled items bearing the radioactive trefoil, appropriately placarded vehicle with locks, no stops near inhabited places, mandatory presence in the vehicle of fire extinguisher, radiation detector, warning equipment and manipulation tongs;
    - Assistance from CNRP to the Tunisian Airports Office (OPAT) with installing at Tunis-Carthage airport (for imports and exports) a fixed and a mobile detection system to monitor declared radioactive packages, primarily for detecting defective packages, but also any that may be involved in illicit trafficking in radioactive sources.

2. Where **waste safety** is concerned the CNRP's activities relate to:

- Management of used sealed sources, consisting in:
    - Returning used sealed sources to the manufacturer;
    - Storing, or conditioning and storing "in situ", used sealed sources in cases where the manufacturer no longer exists.
- Management of radioactive waste generated by hospitals and laboratories using unsealed sources, including storage in decay tanks. The CNRP is responsible for monitoring the waste before its disposal.
- Training of radioactive waste producers. For this purpose, two courses on radioactive waste management in hospitals have been organized, one at the national level at Sousse (CHU Sahloul) and another for the whole Maghreb region, with WHO participation, at Tunis.

- Preparation of regulatory texts specific to radioactive waste management in collaboration with the Legal Unit and the Legal Department of the Ministry of Public Health.

TURKEY

Turkey started its nuclear programme amounting to approximately 2800 MW(e) by announcing an international bidding at the end of last year for the construction of a power reactor in the south of the country. In connection with this, the Turkish Atomic Energy Authority TAEK, as a regulatory body, accelerated the preparation of regulations. In 1997, the following codes of practice entered into force:

- "Code of Practice on Quality Assurance and Inspection of Nuclear Installations" was issued in Official Gazette No. 22932, on 13 March 1997;
- "Code of Practice on Nuclear Materials Accounting and Control" was issued in Official Gazette No. 23106, on 10 September 1997;
- "Code of Practice on Safe Transport of Radioactive Materials" was issued in Official Gazette No. 23106, on 10 September 1997; and
- "Code of Practice on Establishment and Working Principles of Advisory Committee on Nuclear Safety" was issued in Official Gazette No. 23106, on 10 September 1997.

Furthermore, the Advisory Committee examines the licence applications and prepares the Nuclear Safety Evaluation Reports. The Committee studies matters submitted to it by the Atomic Energy Commission, and makes recommendations.

- "A Guide on Protection from Fire of Nuclear Installations" was submitted to the Atomic Energy Commission. After final review by the Commission, the guide will be submitted for final approval; and
- "A Guide on Issuance of Construction License for Nuclear Power Plants" is under preparation and will be submitted to the Atomic Energy Commission for review.

In order to increase overall safety, the Safety Analysis Report of the TR-2 research reactor at Cekmece Nuclear Research and Training Centre was revised and re-evaluated by TAEA with the framework of the IAEA Safety Guides and Safety Standards.

UNITED KINGDOM

THORP

In August 1997, the UK's nuclear safety regulator, the Health and Safety Executive (HSE), granted a Consent to British Nuclear Fuels Limited (BNFL) to operate the Thermal Oxide Reprocessing Plant (THORP) at Sellafield. The Consent was granted following extensive safety assessment and inspection work by HSE's Nuclear Installations Inspectorate (NII) to confirm the adequacy of BNFL's safety management arrangements: work which started in February 1983 on receipt of BNFL's design specification for the plant and which continued through the construction and commissioning stages of the project. Consent to operate marks the completion of the plant's commissioning, begun in 1992, and the move to full operation. NII will continue to exert strict regulatory control throughout the lifetime of the THORP plant by careful monitoring of its operation and maintenance. A programme of regular safety review meetings between NII and BNFL has been planned.

Calder Hall and Chapelcross Magnox power stations

Calder Hall in Cumbria was the world's first commercial nuclear power station commencing operation in 1956, with its sister station at Chapelcross in Dumfriesshire starting up in 1959. On 3 July 1997, NII confirmed that it had completed its assessment of BNFL's Periodic Safety Review (PSR) of these plants. As a result of its assessment, NII is satisfied that it is safe to continue operation of these reactors beyond 40 years operation and on to a potential age of 50 years, subject both to the annual review of the reactor pressure circuit integrity and routine regulatory inspection results.

Hinkley Point 'B' and Hunterston 'B' AGR power stations

In June 1997, HSE published a report summarizing the outcome of the Periodic Safety Reviews (PSRs) of the UK's first two commercial Advanced Gas-Cooled Reactor (AGR) nuclear power stations. The report gave a more detailed account of NII's earlier decision, announced in January 1997, to allow these reactors to continue to operate beyond their 20th year. The two stations, Hinkley Point 'B' in Somerset, and Hunterston 'B' in Ayrshire are owned and operated by, respectively, Nuclear Electric Ltd and Scottish Nuclear Ltd, the two subsidiaries of British Energy plc. In the report, HSE made clear that it was satisfied that the licensees had completed a detailed scrutiny of safety at the two stations and that it is confident that they can continue to operate safely until they are 30 years old. At that point a further safety review will be required.

Trawsfynydd Magnox power station

Magnox Electric has successfully removed samples from one of the Reactor Pressure Vessels (RPV) at Trawsfynydd which is currently undergoing decommissioning. The samples are the full 100 mm thickness of the RPV wall and will provide fracture toughness and metallographic data of relevance to the structural integrity safety cases of other still operating Magnox stations with steel RPVs. The sample removal was a significant achievement as all the access and cutting operations were carried out remotely. The RPV cutting was by an ultra high pressure water jet. Four samples have been removed from one submerged arc weld and none have been found to contain significant defects. Sampling of another weld is due to start shortly.

Trawsfynydd's twin gas cooled Magnox reactors were closed down in July 1993 on economic grounds and the station is now well into decommissioning. Detailed examination of the RPV samples should enhance understanding of the effects of radiation on welds used to construct the vessel.

UNITED STATES OF AMERICA

Reactors

NRC initiatives during 1997 focused on improvements in licensing and inspection programmes for currently operating plants, on ensuring that the necessary framework for plant license renewal is in place, and on licensing of advanced light water reactor designs.

Risk-informed regulatory approaches

The staff continued to implement the Commission's Final Policy Statement on the Use of Probabilistic Risk Assessment in Nuclear Regulatory Activities (60 FR 42622; August 16, 1995). During 1997, NRC finalized guidance related to the use of risk information to make specific changes to a plant's design or operation. This guidance established guidelines for acceptable changes in risk and required that risk information be considered in an integrated fashion with traditional engineering principles (e.g. defence in depth) in making a decision on proposed changes. Application of this guidance was initiated on a trial basis via several ongoing PRA pilot programs in the areas of graded QA, risk informed in-service testing and risk-informed technical specification improvements.

NRC completed its review of 74 Individual Plant Examinations (IPEs) and issued, for comment, a draft report summarizing the results of the IPE program and providing staff perspectives on reactor safety and plant performance. NRC intends to publish the final report in early 1998, and determine necessary follow-up activities, including the identification of possible safety enhancements. The final report (NUREG-1560) provides a valuable source of reference information for use in improving light water reactor (LWR) safety.

Plant licence renewal

The final environmental protection rulemaking for licence renewal (10 CFR 51) was published on 18 December 1996, with an effective date of 17 January 1997. The staff is developing a regulatory guide for the format and content of the environmental portion of a licence renewal application as well as a staff environmental standard review plan. These documents are expected to be completed by March 1998 and August 1998, respectively.

Design certification for next-generation reactors

The Commission issued 10 CFR Part 52 (a rule that sets out a more predictable and stable licensing process, including provisions for certification of next-generation reactor designs) to improve the licensing environment for next-generation nuclear power reactors. The design certification process is the key for early resolution of licensing issues. The status of the three designs under current consideration is as follows:

— Advanced Boiling Water Reactor (ABWR). A final design certification rule for the ABWR was issued on 11 June 1997.

- System 80+. A final design certification rule for the System 80+ was issued on 20 June 1997.
- AP600. In November 1994, the NRC issued a Draft Safety Evaluation Report for the AP600. Final Design Approval is currently scheduled for late 1998.

Radiation protection standards for decommissioned facilities

The NRC amended its regulations to establish maximum permissible radiation levels when a nuclear facility permanently shuts down and is released for other uses. Release of the property may be either:

- Unrestricted, in which case it could be used for any purpose; or
- Restricted so that it could not be used for certain purposes, such as residential housing.

Previously, the regulation permitted licence termination only if radioactivity remaining on the site was low enough to permit unrestricted use of the property. Under the new regulations, a site may be released for unrestricted use if the radiation dose from contamination remaining on the property will be no more than 25 millirems (0.25 mSv) per year. The new regulations permit release of a site for restricted use if the radiation dose from contamination remaining on site will be no more than 25 millirems per year with legally enforceable institutional controls (such as deed restrictions). In addition, if a site is released for restricted use, the licensee must provide sufficient financial arrangements to allow an independent third party to assume and carry out responsibilities for any necessary control and maintenance of the site. There must also be reasonable assurance that, even if the institutional controls are no longer in effect, the maximum yearly radiation dose from contamination remaining on site would not exceed either 100 or 500 millirems (1 or 5 mSv) per year, and be as low as reasonably achievable. Licensees who propose to use the 500 millirem criterion must also comply with several other administrative provisions.

High-level waste programme

During 1997, NRC made significant progress in its regulatory programme for the high-level radioactive waste repository. Among the recent accomplishments in this programme area, NRC reached agreement with the Department of Energy (DOE) on a performance-based programme for resolving the issues of greatest safety significance, which is consistent with Commission initiatives on risk-informed regulatory approaches. NRC and DOE agreed on methods for assessing performance of the repository, for evaluating future climates, and for bounding present-day shallow infiltration at the Yucca Mountain site. The agencies also agreed upon seismic hazard assessment and design methodology, quality assurance programme, monitoring programmes, and the thermal testing programme for the repository. In addition, NRC determined that long-term erosion at the Yucca Mountain site would not be significant with respect to repository performance. Significant progress has also been achieved in resolving issues associated with tectonic and volcanic hazards at the site.

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MEASURES TO STRENGTHEN INTERNATIONAL CO-OPERATION IN NUCLEAR, RADIATION AND WASTE SAFETY

NUCLEAR SAFETY REVIEW FOR THE YEAR 1997

Addenda

1. The Annex to the Agency's Nuclear Safety Review for the Year 1997 (GC(42)/INF/6) presents information provided by Member States on significant national achievements, developments and issues related to **nuclear, radiation and waste safety** during 1997. Information provided by the Republic of Korea is given in the Attachment to this note (with some minor editorial changes by the Secretariat). This information forms an Addendum to the Annex to GC(42)/INF/6 as previously issued.

2. Table II in Part IV of GC(42)/INF/6 (page 35) lists fatal radiation accidents that have occurred in recent years. The following row should be added to Table II as previously issued:

			Early fatalities caused by radiation exposure		
Year	**Location**	**Type of source**	**Workers**	**Public**	**Patients**
1992	China	Lost ^{60}Co source		3	

KOREA, REPUBLIC OF

Regulatory Regime

The Korean Government revised the Atomic Energy Act in December 1996, and its Enforcement Decrees and Regulations in May and July 1997. The highlight of the revision was the establishment of the Nuclear Safety Commission (NSC), which is composed of seven Commission members and chaired by the Minister of Science and Technology. The principal function of the Commission is decision-making on major issues about nuclear safety, regulatory policy and licensing. The Commission was established and began functioning in July 1997. It represents the Korean Government's strong commitment to establishing an independent regulatory authority. This Commission is supported by the Special Committee on Nuclear Safety (25 members), which is made up of four subcommittees: the Reactor Systems Subcommittee, the Radiation Protection Subcommittee, the Environment & Siting Subcommittee and the Regulatory Policy & Systems Subcommittee.

Since 1992, the Korea Institute of Nuclear Safety (KINS) has conducted a series of research projects, under the auspices of the Ministry of Science and Technology (MOSI), to develop strategies on how to implement recent radiation protection recommendations made by the ICRP in 1990. Based on the results of the research, and public hearings conducted for both competent professionals and the general public, the Government revised the radiation protection section of the current atomic energy. laws, so that the ICRP Publication 60 recommendations and the new Basic Safety Standards published by the IAEA in 1996 would be implemented. Also prepared were draft proposals to revise the related enforcement decrees, regulations, and notices for radiation protection. Considering the current technical level of and economic impact to the Korean nuclear industry, the Government decided to incorporate the recommendations of ICRP Publication 60 into Korean regulations on a step-by-step basis with full implementation by the year 2003. These steps can be summarized as follows:

— New annual dose limit of 1 mSv for the general public will take effect in 1998; and

— The dose limit for radiation workers will be 200 mSv for five consecutive years with an annual dose limit of 50 mSv. The dose limit of 100 mSv for five consecutive years, as recommended by the ICRP, will be fully implemented by the year 2003.

MOST/KINS either stipulated or revised a total of 14 nuclear safety standards in 1997. A total of 71 nuclear safety standards have been developed. Among them, 52 standards have been stipulated and put into notices of MOST. The remaining 19 are still in the process of stipulation.

The Safety of Nuclear Installations

Throughout the year 1997, the 12 operating NPPs in Korea, including Wolsong unit 2 which commenced commercial operation on 1 July 1997, recorded no incidents that might have resulted in a radiological impact to the public or the environment.

The ageing degradation of the steam generator tubes of Kori unit 1 caused the plugging rate to increase to 11.5% with the design safety limit being set at 15%. These Westinghouse 51 type steam generators will be replaced by delta 60 type starting in the middle of June 1998. MOST/KINS has conducted safety reviews on the revised technical specifications drafts and final safety analysis reports for Kori unit 1 steam generator replacement.

MOST/KINS has conducted a technical review of the revised fuel design to extend the refuelling cycle of Yonggwang units 3 and 4 from 12 months to 18 months. MOST/KINS has also carried out safety reviews for the Construction Permits of Ulchin units 5 and 6 and for the installation of nuclear fuel test facilities at HANARO, a multipurpose research reactor.

Periodic inspections of 9 NPPS, 2 research reactors and fuel fabrication facilities were carried out. The safety reviews for PHWR and PWR fuel fabrication cacilities were completed in November 1997. The Government issued the following Construction Permits and Operating Licenses in 1997:

— Construction Permits for Yonggwang units 5 and 6, July 1997;
— Operating License for Ulchin unit 3, November 1997;
— Operating License for Wolsong unit 3, December 1997; and
— Early Site Approval for Ulchin units 5 and 6, December 1997.

A special inspection was carried out simultaneously at Kori, Wolsong, Yonggwang, and Ulchin from 19 to 23 May 1997. The inspection was to check the operational and managerial aspects of safety culture, quality assurance, incident and failure management, and radiation protection management according to the IAEA Safety Guide on Operational Safety Assessment. Analysis of the inspection results showed that the operational and managerial aspects of the above mentioned fields were in good standing at each site, and that the NPPs' personnel fully understood the importance of nuclear safety and actively performed safety activities to establish the highest standard of nuclear safety.

Another special inspection on seismic safety of the Kori and Wolsong sites was carried out on 21–24 July 1997. The inspection was to check the operational and managerial aspects of seismic safety management. Analysis of the inspection results showed that the operational and managerial aspects on seismic safety management — such as management of seismic monitoring equipment, appropriateness of the emergency operating procedures, etc. — were satisfactory at both sites.

Radiation Safety

KINS set up the IERNet (Integrated Environmental Radiation Monitoring Network) system in 1996, which is linked online with 17 environmental radiation monitoring stations.

In 1997, KINS began to inform the public of the results of nationwide environmental radiation monitoring on a real-time basis through the Internet service. KINS has also been developing the CARE (Computerized Technical Advisory System for the Radiological Emergency) system since 1993 to provide technical advice and action guides for the protection of the public under a radiological emergency situation. In 1997, KINS connected the plant safety parameters network of the CARE system with Kori units 1–4 and Yonggwang units 1–3. Connections with other operating nuclear power plants will be completed in a few years. In 1997, radiological emergency exercises were carried out at Kori unit 4 and Yonggwang unit 4.

Research & Development

As part of the national long term R&D Programme, the Government has been conducting a 10-year nuclear safety R&D programme which started in July 1997. It consists of three large categories: development of nuclear safety regulation technology, development of radiation safety regulation technology, and development of detailed regulatory requirements. A total of 115 billion Won will be invested in this R&D programme over the next 10-year period. In 1997, 2.1 billion Won was invested in 11 research categories, such as safety analysis, severe accidents, radiation protection, radioactive waste management, etc.

KINS has also been conducting a 10-year research programme since 1992 to develop regulatory requirements and guides for advanced reactors, which are planned to start commercial operation in 2007. A total of 15 billion Won will be invested in this programme over a 10-year period, with 1.8 billion Won in 1997. The development of safety objectives, safety principles and general safety criteria was completed in 1997, and detailed requirements and guides are currently under development. Guides for safety review and safety inspection will also be developed starting from 1999.

Events

The Korean Government hosted the Seoul Conference on Nuclear Safety in Asia on 30 October 1997. Officials from nine countries in Asia and the Pacific Region, along with observers from ten other countries, the IAEA, and the OECD/NEA, participated in this conference. Participants discussed four agenda items: safety of nuclear installations, establishment of nuclear liability regimes and emergency preparedness, a nuclear safety co-operation regime in Asia and radioactive waste management. They agreed on the need to strengthen nuclear safety co-operation in Asia. During this conference, Korea made a draft proposal to establish the Asia Nuclear Safety Consultation Organization (ANSCO), as a regional mechanism for co-operation in the field of nuclear safety among Asian countries. Further discussions on this matter will be made in 1998.

The third anniversary of Nuclear Safety Day was held on 10 September 1997, in which hundreds of people, including the Prime Minister, participated. In 1995, the Korean Government designated the 10th of September as Nuclear Safety Day to promote the awareness of nuclear safety and to cultivate a working atmosphere for better observance of safety principles. Nuclear Safety Day is especially intended to encourage all levels of people working in nuclear fields to have a *proactive* attitude in assuring nuclear safety. To this end, the Government sponsors this annual event to commend the best performing individuals and organizations for their outstanding achievements and services in the area of nuclear safety and to award prizes for the best safety slogans.